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Narrative Economics and Neuroeconomics

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ABSTRACT

This article is a reworked lecture I have given at the Financial University under the Government of the Russian Federation in Moscow. This lecture has considered the epidemiology of narratives relevant to economic fluctuations (outcomes), allowing them to "go viral" and spread far away, even worldwide, and thereby influencing economic outcomes. However, I had to accommodate my talk to the Russian audience adding some illustrative examples for better understanding. My basic goal in this paper is to describe what we know about narratives and the penchant of the human mind to be engaged by them, to consider reasons to expect that narratives might well be thought of as important, largely exogenous shocks to the aggregate economy. Thus, the main focus was on narratives going viral, affecting the economy in an age of neuroimaging, big data. This is because the human brain has always been highly tuned towards narratives, whether factual or not, to justify ongoing actions — even in such basic actions as spending and investing. Though these narratives are deeply human phenomena that are difficult to study in a scientific manner, quantitative analysis may help us gain a better understanding of these epidemics in the future. Many examples are seen as revealing the importance of the linkage of human brains and now computers through narratives associated with popular models of the economy and offering new research opportunities for both economics and neuroscience.
Keywords: narratives; narrative economics; neuroeconomics; neuroscience; animal spirits; economic fluctuations; story; fMRI; meme; epidemic; SIR model; financial bubbles

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Нарративная экономика и нейроэкономика

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АННОТАЦИЯ

Эта статья является переработанной лекцией, которую я прочитал в Финансовом университете при Правительстве Российской Федерации в Москве. В этой лекции была рассмотрена эпидемиология нарративов, имеющих отношение к экономическим колебаниям (результатам), что позволило им «стать вирусными», распространиться далеко, даже по всему миру, и тем самым повлиять на экономические результаты. Тем не менее я должен был адаптировать мое выступление для российской аудитории, добавив некоторые иллюстративные примеры для лучшего понимания. Моя основная цель в этой статье состоит в том, чтобы описать то, что мы знаем о нарративах и склонности человеческого разума к их восприятию, а затем обосновать причины нашего ожидания, что нарративы вполне могут рассматриваться как важные, в основном экзогенные потрясения для экономики в целом. Таким образом, основное внимание было уделено нарративам, которые становятся вирусными, влияющими на экономику в эпоху нейровизуализации больших данных. Это потому, что человеческий мозг всегда был настроен на рассказы, будь то фактические или нет, чтобы оправдать текущие действия — даже в таких основных действиях, как расходы и инвестиции. Поскольку эти рассказы являются глубоко человеческими явлениями, которые трудно изучить на научной основе, количественный анализ может помочь нам в будущем лучше понять эти эпидемии. Многие примеры рассматриваются как важные доказательства связи человеческого мозга и теперь компьютеров через рассказы, связанные с популярными моделями экономики, что и представляет новые возможности для исследований в области как экономики, так и нейронауки.
Ключевые слова: нарративы; нарративная экономика; нейроэкономика; неврология; экономические колебания; история; эпидемия; модель сэра; финансовые пузыри

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INTRODUCTION

Narrative economics and neuroeconomics are both recent economic developments that took place outside of standard economics departments. They came, I would say, from the medical school. You might ask how can that be, how can economists learn from physicians. Well, I think they can and they are. Thus, times are changing. For example, I was at a conference in Toronto of an international organization called the *Society for Neuroeconomics*[1]. They were talking about economics, but there were hardly any economists there that I recognized. Where were they from? They were from medical schools or scientific researcher establishments around the world studying the human brain to get some understanding of economics. Therefore, there were not very many traditional economists here. I think that is how scientific revolutions often begin: you have a toolkit; you have a way of understanding of other things that develop separately. I can think of four different departments of a medical school: *neurology* department that I have already mentioned, but there is also the *epidemiology* department that studies epidemics, that brings me to the *narrative economics* I am going to be talking about. Narratives are stories or ideas that spread like deceases do. The other department that I want just to mention at the beginning is the *endocrinology* department that looks at hormones. There is literature that looks at how hormones affect economics, notably testosterone and oxytocin. Then there is *genetics* department that looks at how your genes affect economic behavior. I am really going to stay in two medical departments today: *epidemiology* and *neurology*. The idea here is to get different prospective on economic science.

NEUROSCIENCE+PSYCHOLOGY+ECONOMICS

This is an outline of my talk: I am going to start with narrative economics and then talk about some recent research in neuroscience. Neuroscience is not my field and I should say upfront that I have no connection with any medical school. But I do believe in reading widely and adapting from other disciplines. And right now there is a revolution going on in neuroscience studying the human brain with new imaging technics, new ways of seeing what's happening in the human brain and it is going to change the way we think. I think economics cannot stay apart from it; it is going to go forward (see, for example, [1, 2]). In terms of neuroeconomics, I was president in the 2016 year of the American Economic Association (AEA), which is the main economists association in the U.S., and I gave my Presidential address (*pic. 1*)[2], which I entitled *Narrative Economics* [3]. And I am trying to argue that economists are negligent in not studying the stories, the narratives that people spread. You can talk about stories using epidemiological thinking. One has to study what I call ***constellations of narratives***, stories that spread together with a common contagion or we can use the German word *Zeitgeist*, the spirit of the time. There are certain times when everybody is telling the same types of stories and they may seem like harmless, silly stories, but they affect the way they think. It is about trying to understand other cultures at different times in history and how they spread in order to understand economic phenomena better.

There are three books I have in Russian (*pic. 2*), but I recently discovered that I have a fourth when a young man just asked me to sign one[3], but there are three which I knew about so far. They all are relevant to narrative economics, the things that I have been developing over the years to try to understand economics from a wider prospect [4–7]. *Irrational Exuberance* — the book that I published in 2000 in English, and it are about financial bubbles and bursts [8]. Then I wrote a book in 2009 with George Akerlof [9]. And the Russian translators did something very strange. They did not ask me, I think it is kind of creative: they translated the title into Latin, rather than Russian, i.e. *Spiritus animalis*. What we are writing about in that book is something different, apparently, that does not translate into Russian; maybe that is why they did it. Spiritus animalis was a phrase used more than 2000 years ago. It means animating spirit; it is what gets you moving. Well, Spiritus animalis has been current for 2000 years. That is a thought as a virus that has not disappeared. However, the meaning has changed over time, especially in the 20th century; it refers now to things that

[1] 15th Annual Meeting SNE 2017 was held October 6–8th, 2017, Toronto, Ontario, Canada. For details, see https://neuroeconomics.org/past-conferences. Neuroeconomics is a nascent field that represents the confluence of economics, psychology, and neuroscience in the study of human decision-making. Society for Neuroeconomics (SNE) exists to foster research on the foundations of economic behavior by promoting collaboration and discussion among scholars from the psychological, economic, and neural sciences, and to ensure the continued advancement of the field of neuroeconomics by supporting young researchers. Researchers from each of these disciplines have investigated decision-making processes for many decades independently, with each discipline offering unique strengths. Accordingly, neuroeconomics combines the rigorous modeling from economics with psychological studies of social and emotional influences on decision-making and utilizes tools from neuroscience that permit the observation of otherwise latent valuation and decision-making computations that take place in the brain. The synergy of this integrative approach is already evident from the steep rise in publications since the advent of neuroeconomics in the early 2000s. For details, see https://neuroeconomics.org/about-sne. (*Editor's note*).

[2] Presidential address delivered at the 129th annual meeting of the American Economic Association, January 7, 2017, Chicago, IL. *(Editor's note)*.

[3] Prof. Shiller told about his book translated into Russian "Finance and the Good Society." Princeton, NJ: Princeton University Press. *(Editor's note)*.

excite you. What gets you out of bed in the morning? You wake up in the morning and you feel sleepy and lazy; you may lie out there for some time, but there is something in your brain that makes you think — hey, it is going to be all right, it is going to be fine. That is your *Spiritus Animalis*. The modern term "animal spirits" from ancient Latin *spiritus animalis* refers to the emotions that drive people to action, and to spend and invest and innovate, and is related to the narrative.

And then the last book with George Akerlof [10] —'Охота на простака', which is another aspect of it — that narratives can be used to manipulate and deceive people. It is not all about it, but a lot of narratives are designed by people who spend their whole lifetime thinking how can I go viral; you know the expression 'go viral' — that means I want my ideas to be spread by word of mouth over millions of people or billions of people, if I am really lucky. So people are scheming to do that. Successful people are often good storytellers.

EMERGING CONCEPT OF NARRATIVE IN MODERN SOCIAL SCIENCE OUTSIDE ECONOMICS AND FINANCE

Let's consider at the beginning the following questions:

The English word narrative may be translated as '*повествование*', but does the sense fully translate?

The narrative is used to refer to a popular story as it is currently being told that seems relevant to the interpretation of current events and human motivation.

Narratives spread like epidemics if they have sufficient vividness, human interest.

The economy in some senses is a network of brains connected by language and narratives.

Well, let me start up with the world '*narrative*' and does it translate into Russian? The dictionary says

Pic. 1. **Robert Shiller's Presidential address delivered at the 129th annual meeting of the American Economic Association**

'*повествование*', but I do not know if it has the same meaning in Russian. In English, the word is very popular outside of economics to refer to a way of thinking, typically a story with human interest that spreads because people like to tell it. And so, often newspapers will say: well the narrative is, meaning that this is the story that people tell these days, a way of explaining what is going on or putting some emotional content of a feeling of loyalty to an idea. People say 'everyone has their own narrative'; it is a story about your life, the way you would like to tell it and it is usually a very self-important story one way or another. What is common the "human interest" structure of stories in all cultures? What is a neurological basis for the generation and impact of such stories?

Narratives usually have visual imagery or human interest, they trigger certain emotions, and if they do it sufficiently strongly, then they go viral. Well, I have a picture here from Stravinsky's The Firebird (Жар-птица — *Zhar-ptitsa*) from the Kirov Ballet (*pic. 3*). The

Pic. 2. **Books related to this paper edited in Russia, two with coauthor George Akerlof**

reason I put it up is I was watching this ballet recently online, there is a scene (maybe many of you have seen this ballet), where the men of this community or village were frozen into stone, they come back as heroes, and this is when they are reunited with their women who are so appreciative. I somehow was watching this scene over and over again; I was like — what is it doing to me? Why is it generating emotions of the heroes returning? I think this is kind of *primordial image*. Carl Gustav Jung (1875–1961), Swiss psychiatrist and psychoanalyst, founder of analytical psychology, thought that there are certain stories that we all respond to. But it has to be done differently. So Stravinsky, when he performed this ballet for the first time in 1910 in Paris, he caught the imagination of Parisians, they loved the story. How did he do it? What is it about there? This is the mystery of narratives that some of them are just contagious and they bring back deep emotions, and we remember them, we want to repeat them when we see somebody. You cannot exactly repeat The Firebird, but often narratives are tellable. Thus, we have here an example of "hero" archetype or primordial image. Narratives are human universal that is every society. They tell stories and every society has stories that everybody knows. This is such a prominent feature of the human species that some experts have argued that we should change the name of our species. We are currently called *homo sapiens*, as you know, meaning in English 'wise men'. But several different authors have given different Latin translations so it is all the same idea: people everywhere tell stories and to find themselves there is a story of my life. Let's call them *homo narrans* [11], or *homo narrator* [12], or *homo narrativus* [13] — Man the Storyteller. Thus, narratives that "go viral" we can consider as major vectors of change in culture. They are the centrality of storytelling in human culture — a human universal.

There is an insight into human behavior that I want to pursue here. I'll give you a simple example of a narrative. This is called *Star Wars* (Star Wars Trilogy 1977, 1980, 1983, Prequel Trilogy 1999, 2002, 2005 and Sequel Trilogy 2015, 2017) — Звездные войны, right? It actually goes back to a play in 1920 by the Czech playwright Karel Čapek called R.U.R. (Rossumovi Univerzální Roboti in Czech or Rossum's Universal Robots in English). That play went viral over the whole world and every language of the whole world got a new word — ***Robot***, which was a Czech word that went everywhere. Those two robots that you see are from the movie *Star Wars* (*pic. 4*). That movie was one of the highest grossing movies. It might even be the highest grossing movie in the whole world. Why was it so successful? I imagine many of you have seen it. Why did it go contagious? We can try to analyze it. I think one reason it spread over the whole world was that it did not

Pic. 3. **Fragment from Igor Stravinsky's ballet "The Firebird" which was first performed at the Paris Opéra on 25 June 1910 by Diaghilev's Ballets Russes**

focus on any nationality; people tend to be suspicious of foreign nationalities. What has said in their byline is: 'Long, long ago in a galaxy far, far away'. It means it is not about America or some other country; it is about some universal thing. What has developed is a story about robots or artificial intelligence, which was another term, as disruptors of our life. One of the themes of this lecture is *big data* and how it can inform research. What about this story about robots? I can track the use of this word Robot through time and I am using called Google Books Ngram Viewer which is a service by Google Corporations that allows you to track the frequency of the use of the particular word among all words or a phrase among all phrases. You can see it with word 'robots'. It starts in 1920 when Čapek wrote his play (it premiered on 25 January 1921), but it wasn't used as much at first as you would think. It really spreads in the late 1970s and you can see a huge explosion in the number of references to robots. I do not know whether it has been just after Star Wars, but something was going viral (*fig. 1*). Another thing I notice at that time was that some Japanese manufacturers were showing off robots and it made international news as well. You can see that the term artificial intelligence increased. This data ends in 2008, so it does not tell you about what is happening now. Why was all this talk about robots in the 1980s and artificial intelligence? The term 'artificial intelligence' was coined in the 1950s with some alarmists' words about what it is going to do to our lives, but it did not have that big impact. I have some other terms that do not show up very well, so I had to delete 'robots' and 'artificial intelligence'. These are two other terms used to refer to the same things at different times in history. You can search Ngrams in Russian, which I tried to do for this lecture, but it did not work so well. I do not think Ngrams is yet strong in Russian.

Let's take one-line term '*labor-saving machinery*', that goes back to the early 19th century. It was grow-

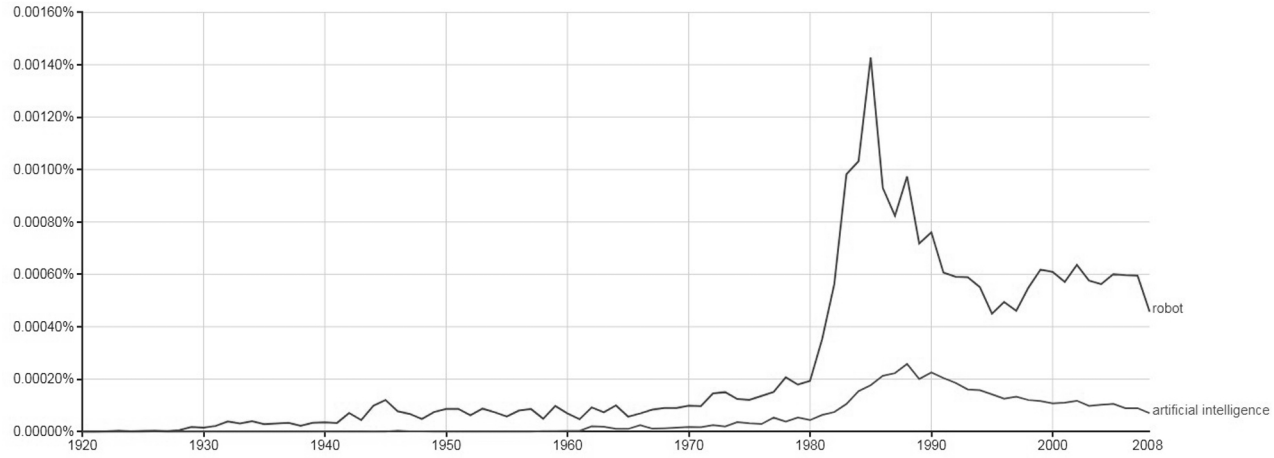
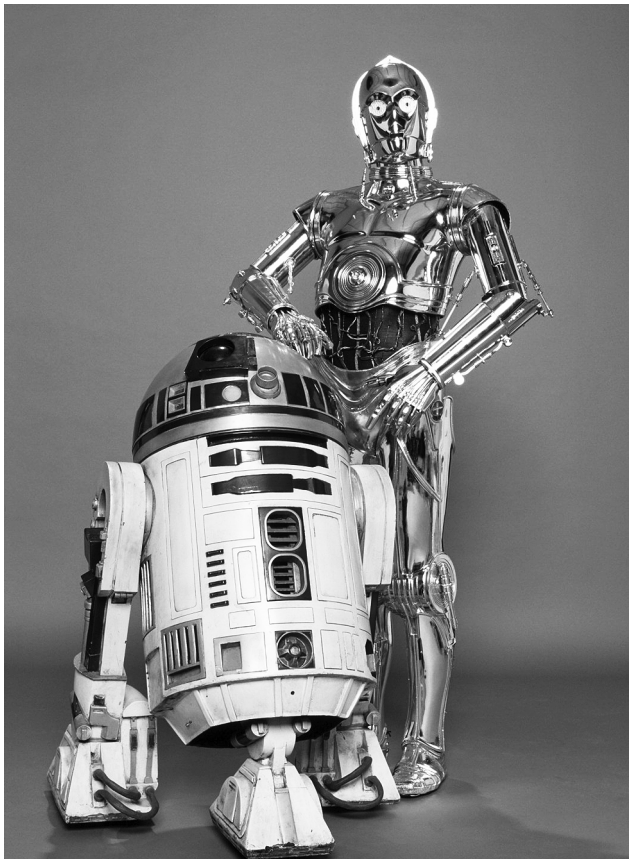


Fig. 1. **Example of a Narrative: Robots take over the world**

ing until the Great Depression and then it declined since then. What happened in the 1930s is that they invented a new word for the same thing. It is not about robots taking over our lives, but you can see the blue line is '*technological unemployment*'. It was the term they invented. Unemployment over the whole was high during the Great Depression. They did not say robots, although they knew the word; they invented the new word, 'technological unemployment'. Next, this is a decline since then (*fig. 2*). This is the same story with different words. Everything we have seen tends to follow a hump-shaped pattern. Labor-saving machinery grew for a while and then it faded. Same things with technological unemployment, there is a pattern that epidemiologists will recognize: when something is contagious it grow for a while, then it reaches its limit and then fades away.

I think this narrative helped to shape economic activity. If you fear that at some point in your life you will be replaced by a machine you will make different economic decisions. And I think that during the Great Depression of the 1930s there was a fear of being replaced by machines. They did not think it was going to be a robot walking around, but they thought it was going to be some kind of a machine. What they were talking about then were whole chemical factories, which were producing chemicals, earlier had 1,000 employees but now there were only two scientists pushing buttons and the whole factory does the thing. That was the narrative. People imagined that this was something that should replace their job and their lives.

I want to bring you up to date on robots and artificial intelligence fear. I think that it has become quite recently — a huge fear especially among young people who are hearing stories about driverless cars, automatic translators, legal research programs; all things about artificial intelligence have scared people recently, and



Pic. 4. **A little astromech droid, R 2-D 2 and gold C-3PO droid programmed for etiquette and protocol, and a constant companion to astromech R 2-D**

it is a big narrative right now what might help explain stagnation. However, I am trying to get what is the current name for this narrative. This is a different search; this is on *Google Trends* which searches what people are searching. It only goes back to 2004, and the early years are not that accurate. Now people go online when they search for terms that they are interested in. Just this year, in 2017, there is a huge increase in searches

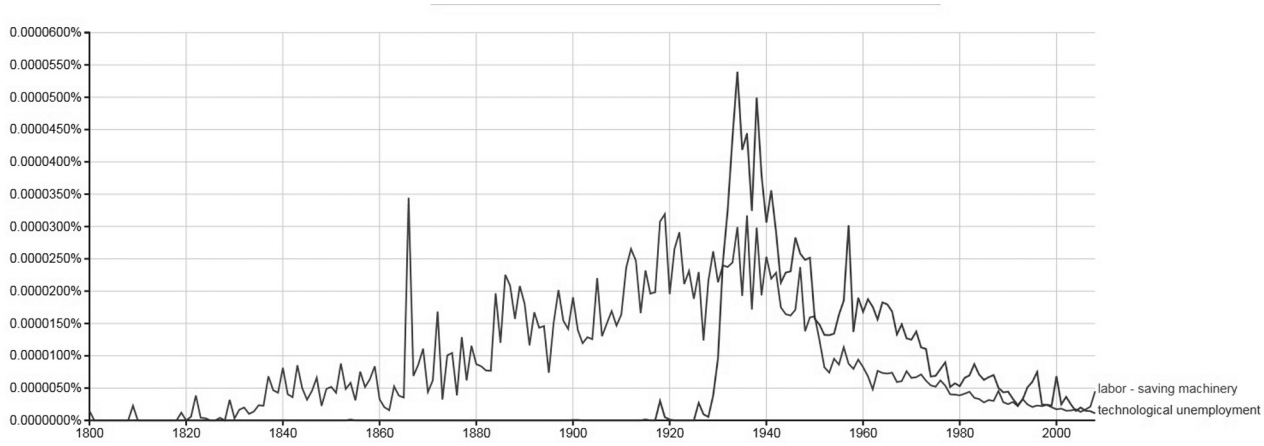


Fig. 2. **Google Books Ngram Viewers chart for terms 'technological unemployment' and 'labor-saving machinery'**

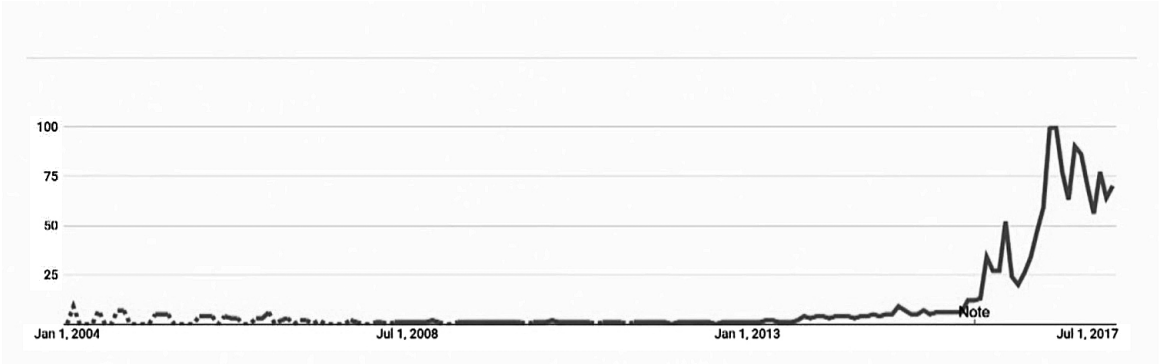


Fig. 3. **Google Trends search for "Universal Basic Income" as a marker for fears of technological unemployment 2004–2017**

for Universal Basic Income (*fig. 3*)[4]. What is talked about there is a sense that poor people are going to be useless soon because everything can be automated that is routine. All we need, it is just a few of entrepreneurial type of scientists. So what is going to happen? People are thinking — I want to know what society can do about it. And 'universal basic income' is the word of the moment. It means that we should pay everyone an income, not welfare, not charity; it is just a fact of life, everyone gets an income for free without working and you can see it has exploded recently. I am interested in that narrative and how it is going to change economic behavior in the future.

[4] **A basic income** (also called *basic income guarantee*, *citizen's income*, *unconditional basic income*, *universal basic income* (UBI), *basic living stipend* (BLS) or *universal demogrant*) is a form of social security or welfare regime, in which all citizens (or permanent residents) of a country receive a regular, liveable and unconditional sum of money, from the government. Payments do not require the recipient to work or look for work and are independent of any other income. The world's first universal basic income referendum in Switzerland on 5 June 2016 was rejected with a 76.9 percent majority. Also in 2016, a poll showed that 58 percent of the European people are aware of basic income and 65 percent would vote in favor of the idea. For details, see https://en.wikipedia.org/wiki/Basic_income. (*Editor's note*).

THE ROLE OF NARRATIVES BROADLY, IN THE SOCIAL SCIENCES AND THE HUMANITIES

Many social sciences have been increasingly interested in narratives, especially over the last ten years. But economics and finance are the least interested. There is another search engine; this is JSTOR that searches scholarly journals. I did a search for the word 'narrative', by profession, by social science, the percentage of articles that contains the word *narrative*. Economics and Finance are the social sciences that have the least use of the word.

I think we are moving towards a better world where this is going to be talked about more. Fields that talked about narratives more are history and anthropology. What I am really interested in are historians who do history by telling you what stories were motivating at previous times. Often you read about history where they talk about some war or some leader. And you just cannot imagine what these people were fighting about. Why did they think there is anything going on to justify a war? You have to tell these stories, so for example historian Ramsay MacMullen wrote a book called *Feelings in History* in which he tells stories that he managed to find out about, which are often not written down, to explain

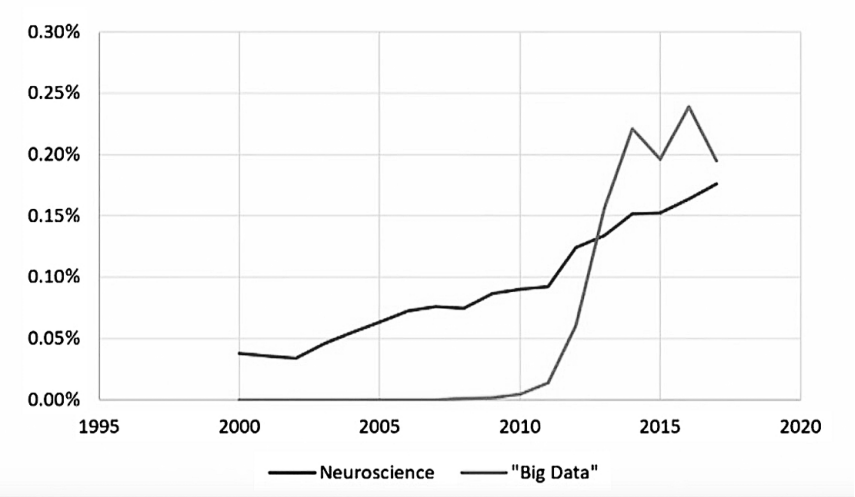


Fig. 4. **ProQuest News & Newspapers Scaled Counts Show Explosion of Public Interest in Both Neuroscience and Big Data**

why people got emotional about some things and why did they want to fight this war [14]. That is a narrative version of history.

I am using here big data to support understanding of these transient narratives (*fig. 4*). As you know, we now have a digitalized world. I can search narratives in different fields. Personal diaries are starting to go online. If you keep a diary you've got to remember that you are going to be online someday. When you die your grandchildren will give your book to a library and it will be digitized and searched over. Church sermons from the past are getting digitized too. How about comic books, comic strips? All these things are becoming digitized and we are trying to understand how people think in a different period of times.

FROM NEUROSCIENCE TO NEUROECONOMICS

There are two revolutions going on that I am going to talk about in this lecture. *Neuroscience* is expanding rapidly. I went also a few years ago to society for neuroscience which is not just neuroeconomics, and I was just amazed how many people are interested in this field and how much is being developed, that already is getting behind anything that one can easily appreciate. Let us look at the US unemployment rate, from 1890 to the present. These are the people who cannot find a job and would like to find a job. If you look at this, it has a very interesting spiky shape. There are episodes of high unemployment every five to ten years. And there were a couple of major episodes. So, you can see that the highest point is the Great Depression of the 1930s and that narrative is still remembered, and, in fact, it is remembered increasingly well. It is something I will show you later. But go back to the very far left — you will see the depression of the 1890s. We've completely forgotten it now, right? It's not as big. Why did we forget completely about the depression of the 1890s? Because it is not a good story anymore, it's not contagious, because we have a better story, the Great Depression of the 1930s. Thus, must of us do not even know that the other one happened.

What tends to happen in history is that economic events are played out as possible repetitions of some other events that are still contagious narratives. Psychologists Daniel Kahneman and Amos Tversky talk about *representativeness heuristics* [15]. You have on your mind certain representative facts of history and you keep saying — is it this again? So still on our mind is the Great Depression of the 1930s. We erroneously imagine that that whole story might repeat now. We have seen the movements in the stock markets; we have the US stock market price in blue line here, and we have the earnings earned per share in the US stock market in green, back to 1879 (*fig. 5*).

Again, I like history. I am saying that we do not understand current events unless we understand historical events. What really stands out in the figure is 1929, that is the stock market crash of 1929. However, just as surprising is this huge increase in stock prices in the eight years before 1929. We would like to understand why that "bubble" and later "burst" happened. Conventional finance would tell you markets are efficient, there must have been new information about technology or human tastes, encouraging evidence before 1929, and discouraging after, that happened to have that pattern. The theory implies that the news is ultimately grounded in objective reality. Do you believe that? Maybe at some level, you do. But I am thinking something else was happening in the years up to the 1929 peak and then something abruptly happened thereafter. A lot of people went back trying to understand why it changed so abruptly in 1929. And look at things — what the central banks did and what speeches were made by Prime Ministers. I think maybe there is something else that is more narrative-based. Looking

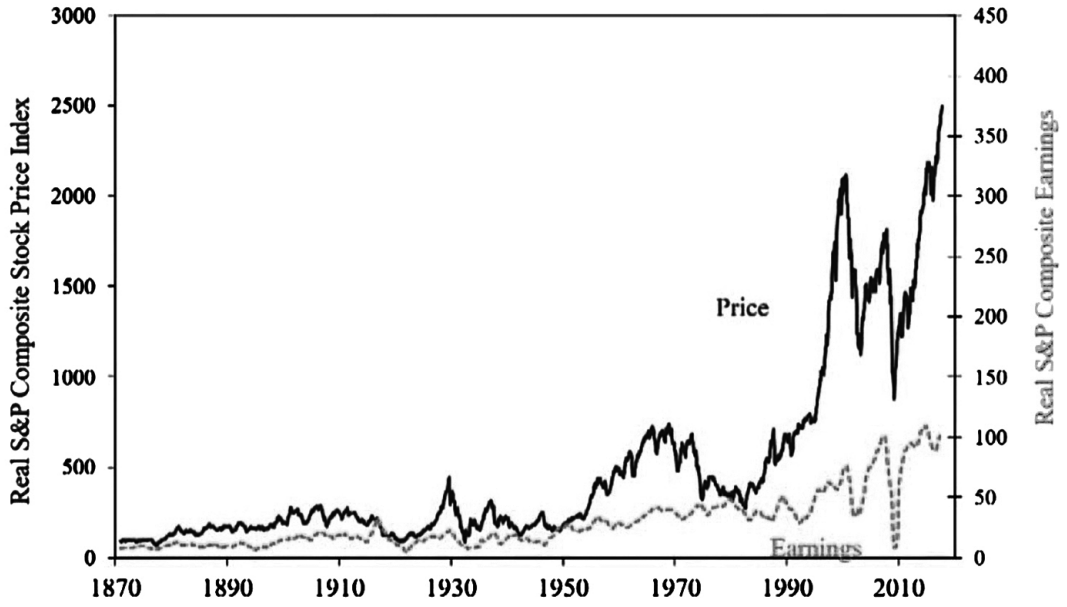


Fig. 5. **Real (inflation-corrected) U.S. Stock Price Index and Earnings 1871–2017**

again at *fig. 5*, with the recent year, you see the US stock market again right now, just soaring. So people ask why it is soaring. There is a parallel question about the Russian stock market, which is doing the opposite. The US market looks way overpriced to me and the Russian market looks way underpriced to me. Why is that? Does anyone in finance have an explanation? I think that an explanation is not impossible to find, but it needs some repositioning of our methods and we have to start thinking about what people are thinking. It cannot always be dignified because sometimes people are thinking silly things and economists do not want to get into that territory.

Nevertheless, I want to get into it, as it strikes me as reflecting objective reality. So this big move up to the peak in 1929 is something to do with 'the roaring 20s'[5]. There was the whole culture that developed that encouraged enthusiasm and willingness to spend money. And then it was changed with a failure of the economy and the narrative changed. The narrative in the 1930s was those business people of the previous decade were corrupt and evil, women were too free with their revealing clothes. They moved in the 1930s into another psychology. By the way, this downturn (I am showing it for the US), was bigger for Germany. Germany was maybe the worst-hit country in the world from 1928 to 1933. Nazi sympathy kept rising and eventually it led to the election that led to Adolf Hitler takeover. So people in Germany were getting angry about something and they were telling stories that tended to be increasingly anti-Semitic, dangerous stories that started to spread like a narrative. Economists want typically to keep their discipline apart from political science or history, but you cannot be aside as the big events that we care about really involve our whole lives, involve our sense of meaning in our lives, involve the kind of narratives that we are telling.

This is both, *Google Books Ngram Viewer* search for book *and ProQuest*, that is another database, search for news and newspapers. What I am doing here is looking for the phrase 'Great Depression' referring to the 1930s. People began capitalizing the first letters of the two words, meaning that they started taking it as a title for a unique event. What you can see is that over the century from 1930 when the Great Depression began until the present there has been a general uptrend in the use of the term Great Depression (*fig. 6*). It was not forgotten, it was increasingly remembered. It approached legendary status. And then when we had the global financial crisis of 2008–2009, it reached absolutely abnormal proportion, everyone was talking about the Great Depression. Our world financial crisis then was I think substantially caused by the memory or the narrative of the Great Depression about seventy years earlier. At this point, in 2008–2009, hardly anyone was alive who could remember experiencing the Great Depression. It was all word of mouth, indirect. But what it does — it makes people afraid to spend and they want to pull money out of the banks, as they remember there were bank runs in the Great Depression. One of

[5] The ***Roaring Twenties*** was the period of Western society and Western culture that occurred during and around the 1920s. It was a period of sustained economic prosperity with a distinctive cultural edge in the United States and Western Europe, particularly in major cities. The Wall Street Crash of 1929 ended the era, as the Great Depression brought years of worldwide gloom and hardship. (*Editor's note*).

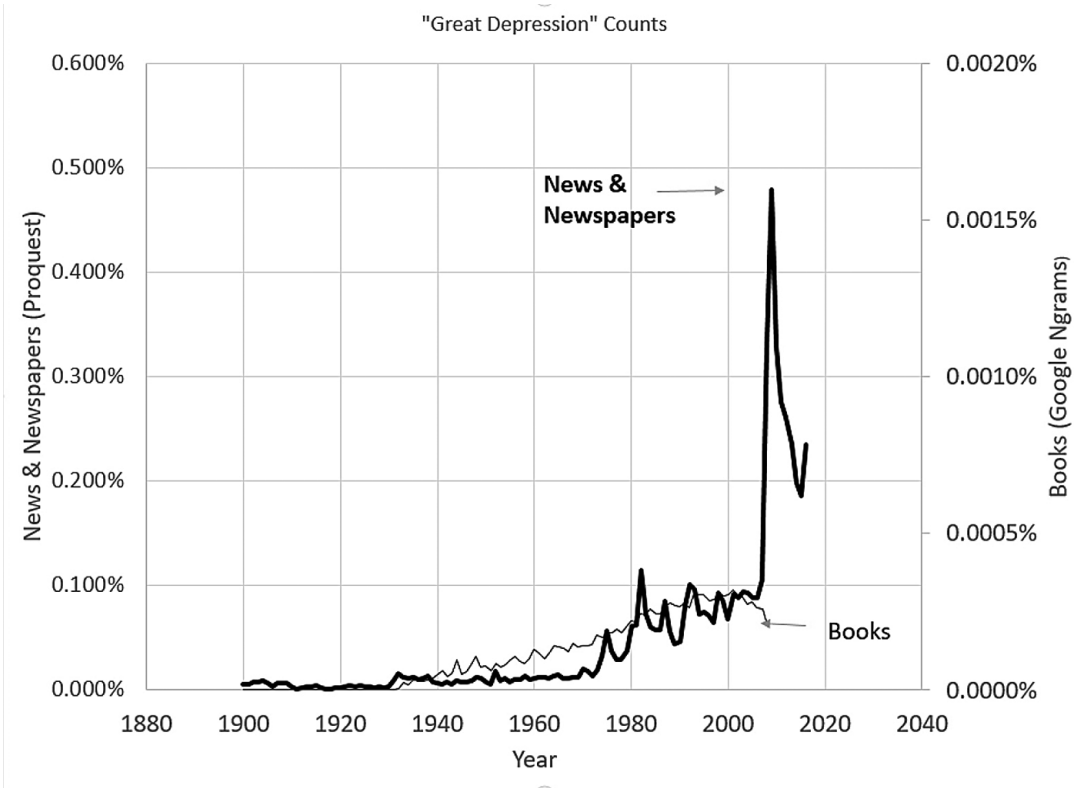


Fig. 6. **"Great Depression" counts as a percent of the database each year**

the great things central banks around the world did in 2008–2009, because I think that they had some intuitive understanding of narratives, despite their training, is that they did not want people to lose their money. In a bank run it started with Northern Rock bank in 2007 in the United Kingdom, the British government decided to bail everyone out, so that no one loses money. They did not want the narrative to go viral, maybe they did not say it. But I am interpreting what they thought. And then later the US Fed did the same thing. Because when it starts, when people start telling the same story that money is not safe in the bank, they would totally unravel the financial system. One important thing for policymakers is not to let narrative get started, take immediate action.

Some people would say I have not proved causality. I have given examples of narratives associated with economic events. However, how do you know that the narratives caused these events? Maybe causality goes from the event to the narrative? I cannot prove it. Therefore, the general idea is if you tried to write an article, submit it to an economics journal, and have to go through the refereeing process, the referee would likely say you have not proved the cause. The problem with economics is that it cannot run a controlled experiment. If you are testing drugs, you can have a control group and experimental group. And they do not know if they are getting medicine or a placebo, and you can find out whether the drug helped or not. But you cannot start a Great Depression as an experiment. But there are other fields that have shown that narratives do change people's behavior. Jennifer Escalas from Vanderbilt University [16–19] has done a study of how much different responses are to an advertisement if you have a scientist explaining the product and they have done research and found out that it works, and if someone like your neighbor telling you in a friendly way he uses this product, and he likes this product. She proved basically that the narrative-based advertising works better. We know that people are motivated by narratives. I do not think it is possible that the recent financial crisis had nothing to do with the narrative of the Great Depression.

ANALOGY WITH EPIDEMIOLOGY

Now I am going into *epidemiology*. We are shifting now to a medical school. I apologize for some equations. This is, maybe, the most important mathematical model of an epidemic in the history of epidemiology. It was a paper written in 1927 by Kermack and McKendrick that built three differential equation models [20]. Their mathematical theory of disease epidemics marked a revolution in medical thinking because it gave a realistic framework for understanding the all-important dynamics of infectious diseases. Moreover, this is a very simple model.

I do not want to get into mathematics too much. The general idea is that there are three groups of people in population anytime: the *susceptibles*, people who have not

had the disease and are vulnerable; the *infectives*, people who have the disease and are actively spreading it; and then there are the *recovereds*, people who have had the disease and gotten over it and are no longer capable of catching the disease again or spreading it. Hence, it is called an SIR Model or compartmental model. We keep population constant at the end. Also, we assume that no one dies from the disease, but once one had it, he/she is immune after a while. The number of recoveries is equal to a recovery rate.

The main assumptions in Kermack–McKendrick SIR Disease Epidemic Model 1927 are as follows:

S = fraction of population *susceptible*

I = fraction of population *infected* and now contagious

R = fraction of population *recovered* and now immune

S + ***I*** + ***R*** = N, the total population N is assumed constant

c = contagion rate and

r = recovery rate.

Further, it is assumed that in a thoroughly mixing population the rate of increase of infectives in a disease epidemic is equal to a constant contagion rate $c > 0$ times the product of the number of susceptibles ***S*** and the number of infectives ***I*** minus a constant recovery rate $r > 0$ times the number of infectives. Each time a susceptible meets an infective there is a chance of infection. The number of such meetings per unit of time depends on the number of susceptible-infective pairs in the population. The recovery from the disease is assumed to occur in an exponential decay fashion, instead of the more usual notion of a relatively fixed timetable for the course of the disease. The three-equation Kermack–McKendrick SIR model is:

$$\frac{dS}{dt} = -cSI \quad (1)$$

$$\frac{dI}{dt} = cSI - rI \quad (2)$$

$$\frac{dR}{dt} = rI \quad (3)$$

The size of the epidemic, the total number who caught the disease eventually and are now immune, depends only on the *ratio* of contagion rate ***c*** to removal rate ***r***. The speed of epidemic holding ratio ***c***/***r*** constant depends on their *levels*.

Recoveries can only increase, the way they increase by infected people recovery that is a recovery rates times by the number of infected. The number of susceptibles goes down by the number by the product of the number of susceptibles and infected. The equations have to sum to zero. This is a change in infectives.

Let me summarize. Basically, epidemics grow when people are catching the disease faster than they get over it. How many people catch the disease depends on the number of susceptibles times the number of infectives and the contagion parameter ***c***. Even if the contagion parameter and the recovery parameter are constant through time, the epidemic will form a hump-shaped pattern of infectives. Initially, epidemic goes fast as there is a large number of susceptibles and the infectives are very successful in spreading the disease. Then eventually the number of susceptibles is depleted and we reach a stage when there are not enough new meetings between susceptibles and infectives to spread the disease further. Thus, it is going away. There are two parameters: the *contagion rate* ***c*** and the *recovery rate* ***r***. Look at *figure 7*.

The black line is the example of the solution for the Kermack and McKendrick differential equations. But the solution for I tends to look like this: hump-shaped pattern in the number I of infected. Also shown is the number of susceptibles and recovereds. R eventually gets close to a hundred, S gets close to zero. Not everyone gets the disease. It is never in fact 100% of the population. The bottom line is there are fast epidemics and slow epidemics depending on how contagious the disease is and how fast they recover. There are big and small epidemics. During an actual epidemic, public attention tends to focus on the number of infectives, seen here as a bell-shaped curve skewed to the right.

SOME ILLUSTRATIVE EXAMPLES OF NARRATIVES

Just to improve on intuition on this, I did Google Books Ngram Viewer search for popular Russian authors. And this is a number of times these authors were mentioned in books in the English language and you can see there are hump-shaped patterns (*fig. 8*). These are the 19th-century greats. They have all grown and then they are all declining, just as the infectives curve in *fig. 7*. This is just a fact of life. Famous people all act that way, they grow in fame for a while but eventually, they start to be forgotten. They never completely disappear from public memory, but they just dwindle away. Unless something changes the parameters *c* and *r* so that an epidemic might come back, I do not mean to pick on Russian authors so I will show you American authors, English authors (*fig. 9*). The same thing. Some of them are big. The American poet Henry Wadsworth Longfellow (1807–1882) was very popular in the 1880s, but no longer. It seems like it is a sad fact of life. You might imagine someday you will be famous someday, and you will have growing fame after you die, but there is another death, eventually — your fame starts to dwindle because people just forget about you. That is for Kermack–McKendrick models. This is for

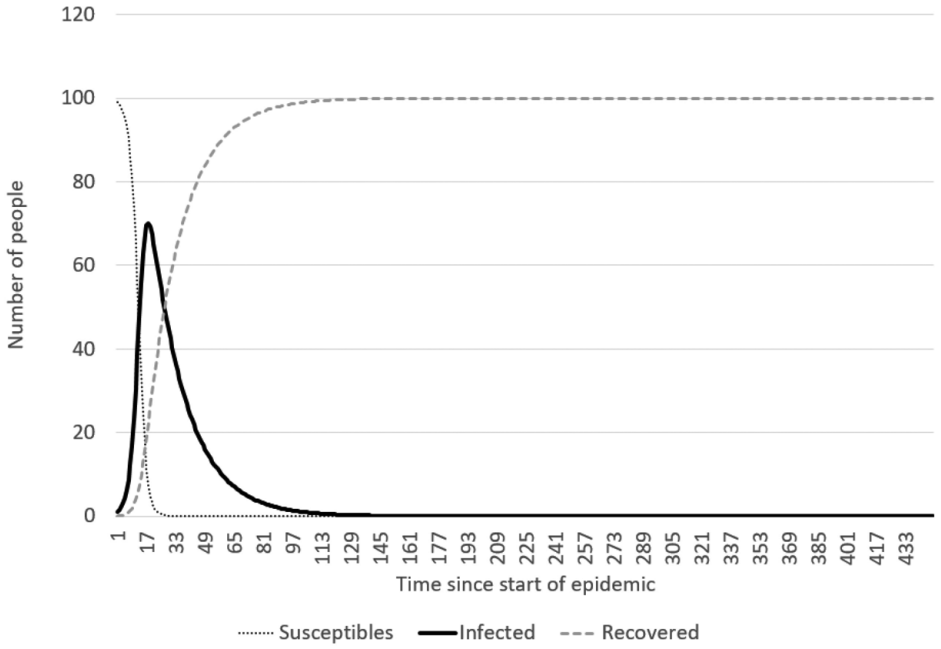


Fig. 7. **Time paths of S, I, and R in Kermack–McKendrick SIR Model for $N = 100$, $I_0 = 1$, $c = .005$, $r = .05$**

Fig. 8. **Google Books Ngram Viewers counts for popular Russian authors**

Russian composers (*fig. 10*). These are Soviet leaders they are all hump-shaped (*fig. 11*). Look at Khrushchev — it is a beautiful Kermack–McKendrick curve; the same with Gorbachev. This implies no criticism of these people. It is just reality, that life is a sequence of epidemics.

SOME NARRATIVE EPIDEMICS OF ECONOMIC THEORIES

However, I am not going to go through this mathematics. Economists like to build mathematical models that make no use of idea contagion, except something that goes mechanically to economic channels. We need to go to story contagion. When I looked at famous novelists, composers, they can do something magical. What is it? It is something that we need neuroscientists to get at. This is, by the way, a plaque showing how economic models have common goals. The IS-LM model, real business cycle model, multiplier-accelerator model, overlapping generations model — they all had the same hump-shaped pattern over time. To a purist, they all are wrong, they are all just models. They are all partly right. The interesting thing is that they often go through bubbles that started 10 or 15 years after they were published and the epidemic does not have to end, maybe these authors are dead now, not all of them. The epidemics still goes on.

I have Google Books Ngram Viewer results for several examples of economic theories, though less appropriate for our purposes because they are not just narratives. Even important original theories have associated narratives and might have SIR dynamics. All models show hump-shaped patterns akin to those that can be produced by the Kermack–McKendrick model. In three of the cases, the

Fig. 9. **Google Books Ngram Viewers counts for popular English language authors**

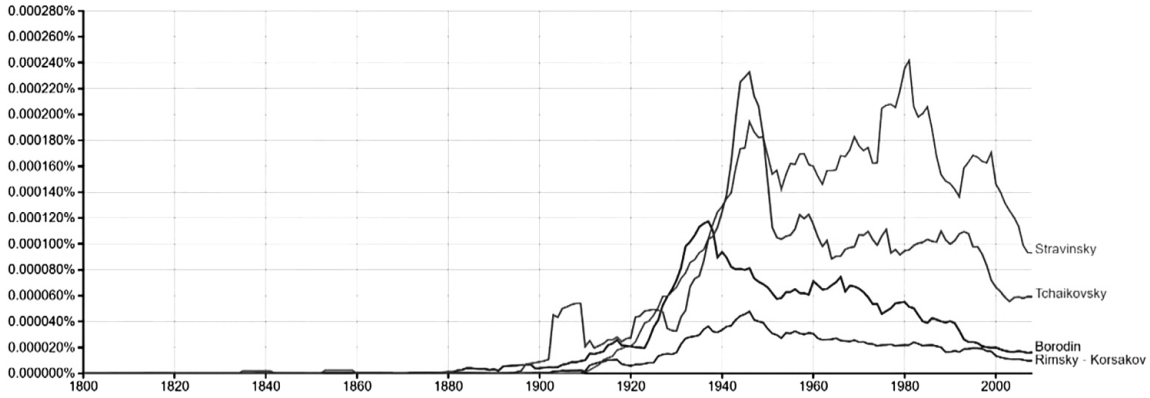


Fig. 10. **Google Books Ngram Viewers counts for Russian composers**

Fig. 11. **Google Books Ngram Viewers counts for Soviet leaders**

epidemic first became visible more than a decade after the model was introduced, a phenomenon that is also explainable within the Kermack–McKendrick framework, where epidemics may go unobserved for a while after they have just started from very small beginnings.

SOCIAL DIMENSIONS OF EPIDEMICS

I am looking at other things and this is Ngram that shows public attention to various terms. You probably never hear about *autosuggestion* (*fig. 12*). What in the world is going on here? Do you know what autosuggestion is? It is a view that self-esteem is very important and you have to protect your sense of worth. What you should do according to French psychologist Émil Coué[6] is you should

[6] Émile Coué de la Châtaigneraie (1857–1926) was a French psychologist and pharmacist who introduced a popular method of psychotherapy and self-improvement based on optimistic

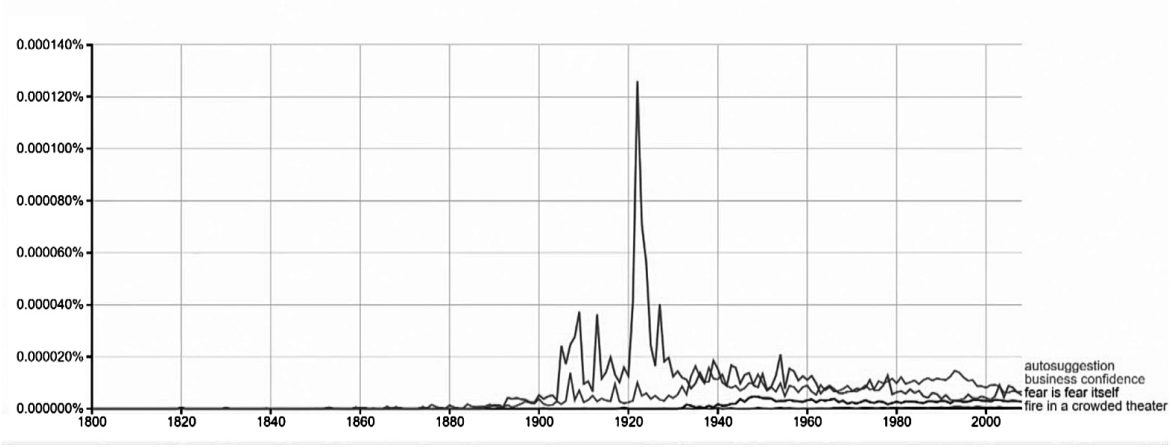


Fig. 12. **Google Books Ngram Viewers for autosuggestion, business confidence, fear is fear itself, shouting fire in a crowded theater**

every day tell yourself that you are great. Keep saying that and it will happen. For some reason in 1920–21 people loved Émil Coué and they thought it is the solution to life's problems. But it failed; it again follows an epidemic curve. It was at the beginning of The Roaring 20s. I take, for example, some other terms: 'business confidence', 'fear itself', shorten for 'fear is fear itself', 'shouting fire in a crowded theatre'. Some of them are slow and some of them are fast epidemics. This is amusing and, maybe, a little controversial.

Karl Marx, the Father of Communism. I always wondered how he gets to be a Father of Communism. I read his biographies. When he died in 1883 you can see he was not that famous in 1883, one historian said only about 20 people went to his funeral[7], but he had started an epidemic. He did not peak until the 1970s. There was another epidemic going on at the same time, for the Greek god Zeus. Karl Marx almost got as big as Zeus but did not quite make it (*fig. 13*). Zeus, he does not even exist, he never existed, but it turns out there was a classic revival in the 19th century. You do not even have to exist to go viral! What is so good about this Zeus story: I do not know, but it is something that had been lasting for more than 2,000 years and something makes it contagious again. It is like influenza, suddenly there is an epidemic, something increased the contagion rate and it goes to the epidemic, but it is not going to get everyone, eventually there will be a decline.

Albert Einstein (1879–1955), everyone heard of him, he is a famous genius. When you say genius this is the name that comes up most commonly. But what about poor Erwin Shrödinger[8]. He is just not as well known, but I think if you stand their work side by side it is hard to say who is greater. Why is Einstein so much more famous than Schrödinger? Is not Schrödinger's quantum mechanics (with Schrödinger's Cat, etc.) just as fundamental as the theory of relativity? They both did important work in theoretical physics. Einstein looks like Zeus, like some kind of prophet or sage. Shrödinger is nice looking, but just not a great story somehow. So Einstein has been going long after his death, he has some kind of story quality that inspires people (*fig. 14*).

EXPANDING THE CIRCLE: NEUROSCIENCE

Well, I want to get into *neuroscience*. Something goes in people's mind to make stories sound exciting or interesting to them. Thus, we have attempted to scientifically pursue "going viral." For example, in neuromarketing neuromarketers test commercials having subjects view them with fMRI. There is a new field developing now in marketing. That is another department of the university that has a lot of insights about what people think. However, this is not widely applied in finance and economics. Now neuromarketers are increasingly using digital or neuroimaging techniques that put subjects into fMRI machine

autosuggestion. The application of his mantra-like conscious autosuggestion, "Every day, in every way, I'm getting better and better" (French: *Tous les jours à tous points de vue je vais de mieux en mieux*) is called *Couéism* or the *Coué method*. Some American sources quoted it differently, "Day by day, in every way, I'm getting better and better." (*Editor's note*).

[7] As a matter of fact only 11 people went to Marx's funeral. (*Editor's note*).

[8] Erwin Rudolf Josef Alexander Schrödinger (1887–1961 was a Nobel Prize-winning (1933) Austrian physicist who developed a number of fundamental results in the field of quantum theory, which formed the basis of wave mechanics. He formulated the wave equation (stationary and time-dependent Schrödinger equation) and revealed the identity of his development of the formalism and matrix mechanics. Schrödinger proposed an original interpretation of the physical meaning of the wave function. For details, see https://en.wikipedia.org/wiki/Erwin_Schr%C3%B6dinger. (*Editor's note*).

Fig. 13. **Google Books Ngram Viewers for Karl Marx (1818–1883) and Zeus**

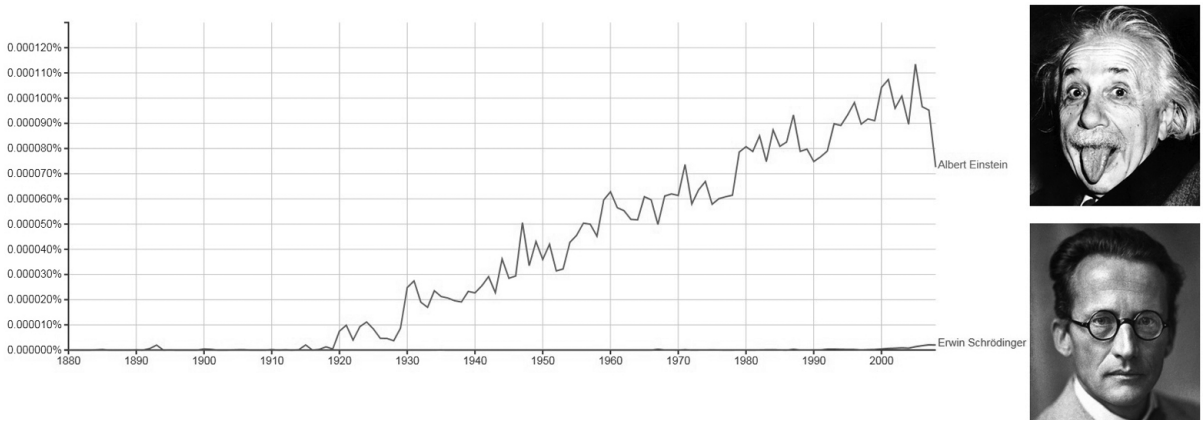


Fig. 14. **Albert Einstein vs. Erwin Schrödinger**

and have them watch commercials and they look at the brain, how the brain responds. Maybe it is hyped a little bit, but they look at how to ads' design stimulate particular regions in the brain. There are some controversies as well. Martin Lindstrom editorial in New York Times (September 30, 2010) in article *You Love Your iPhone, Literally* wrote: "But most striking of all was the flurry of activation in the insular cortex of the brain, which is associated with feelings of love and compassion"[9]. In the letter to NYT (Oct. 4, 2011) signed by Russell Poldrack, professor of psychology and neurobiology at the University of Texas at Austin, and 44 neuroscientists they respond: "The kind of reasoning that Mr. Lindstrom uses is well known to be flawed, because there is rarely a one-to-one mapping between any brain region and a single mental state; the insular cortex activity could reflect one or more of several psychological processes"[10].

This means that the challenges to neuromarketing are great, given the great complexity of the brain. But, with time, neuromarketing is overcoming the obstacles. In the opinion of Roger Dooley from Forbes Magazine (February 24, 2015) we are already there: "Neuromarketing: Pseudoscience No More"[11]. As Vinod Venkatraman et al[12]. wrote: "The key here was to do a more carefully controlled study where all the methods are being treated equally in terms of the protocol. For every method, the protocol is exactly the same… Then, we collected real-world performance data based on what happened to the product that was featured in the ad" [21]. And fMRI proved useful in predicting the success of ads.

[9] http://www.nytimes.com/2011/10/01/opinion/you-love-your-iPhone-literally.html. Martin Lindstrom is the author of "Brandwashed: Tricks Companies Use to Manipulate Our Minds and Persuade Us to Buy."

[10] http://www.nytimes.com/2011/10/05/opinion/the-iphone-and-the-brain.html?_r=0.

[11] https://www.forbes.com/sites/rogerdooley/2015/02/24/neuromarketing-temple/#54342e8ede94. See also: http://www.rogerdooley.com/ep-45-scientists-get-closer-to-the-buy-button-in-the-brain-with-angelika-dimoka-paul-pavlou-and-vinod-venkatraman.

[12] From Temple University's Center for Neural Decision Making at the Fox School of Business. For details, see http://www.fox.temple.edu/institutes-and-centers/center-for-neural-decision-making/people/.

NEUROAESTHETICS AND THE HUMANITIES

There is also a lot of research now about neurosciences, *neuroaesthetics*. Scholar.google.com gives 2,780 hits for "neuroaesthetics". We need to complete neuroaesthetics to understand why narratives become contagious. What does determine our sense of beauty? In his last book, *The Evolution of Beauty*, Richard Prum[13] [22] invokes Darwinian sexual selection: *Fisherian Runaway* is a feedback model analogous to the Kermack–McKendrick epidemic model, which may generate bubbles in species analogous to speculative bubbles.

AESTHETICS AND VIRALITY RESEARCH

It is all about *Big data*. What makes a painting beautiful? What makes a symphony beautiful? Why some symphonies are remembered and others are not? What parts of your brain light up when music does something? We still do not understand these things. Jodie Archer and Matthew Jockers have written a book called *Bestseller Code* [23]. They get a computer product to predict which novel will be a bestseller, will be a success. Now they claim they can predict that by feeding it in their program. There is some advice if you want to write a novel. There should be: the heroine should be 28 years old, there should be love scene that appears around the middle pages of the novel, and then count the pages that imply "closeness". Readers of novels love those scenes. This was discovered by a computer program, which they claim is the most successful in predicting bestsellers[14].

Other people predict what articles in newspapers are emailed and then they have spread around. In a paper titled *A Neural Model of Valuation and Information Virality* [24] the authors wrote: "We analyzed brain responses to *New York Times* articles in two separate groups of people to predict objectively logged sharing of those same articles around the world (virality). Converging evidence from the two studies supports a unifying, parsimonious neurocognitive framework of mechanisms underlying health news virality." By virality, they understand the tendency of an image, video, or piece of information to be circulated rapidly and widely from one person (for example, an Internet user) to another or the quality or fact of being viral. Here they present a unifying neurocognitive framework of mechanisms underlying information sharing at scale (virality). The work has been conducted in the Communication Neuroscience Laboratory at the Annenberg School for Communication at the University of Pennsylvania.

GUT FEELINGS ABOUT TRAJECTORIES

There is other research by a psychologist on how we evaluate trajectories. I would like to cite a book titled *Gut Feelings* [25] (*pic. 5*) talking about how the brain processes and makes predictions. One example is a ballplayer who is trying to predict how fast to run in order to catch a ball. The mind does the certain subconscious trick, like keep the angle of inclination constant when you are running. The subconscious affects your impression of other trajectories, like trajectories in the stock market.

'Can following your gut feelings lead to some of the best decisions?' 'Can we trust our guts?' Gerd Gigerenzer (born 1947) in his book *Gut Feelings* puts these intriguing, even if superficially naïve, questions. The author defines a gut feeling as 'a judgment that appears quickly in the unconscious; whose underlying reasons we are not fully aware of and is strong enough to act upon' [25, p. 16]. People subconsciously discover rules of thumb to solve complex problems. Sometimes it leads to error. He says these intuitions are evolved rules of thumb which reside in the mind's 'adaptive toolbox' [25, p. 19] and they are as valuable as other evolved capacities such as language, recognition memory, imitation and emotions [25, p. 58]. Intuitive decision-making relies on gut feelings or hunches, which are subconscious. Unlike 'rational' (conscious) decision-making, the subconscious has a much larger capacity; the book, therefore, argues that in many situations, intuitive decisions generate better judgments. I think ego involvement develops with these subconscious abilities, affecting such things as impressions of likely end of the recession or of the timing of the stock market.

Gut feelings rely on heuristics or shortcuts. We can define the *gaze heuristic* as a heuristic used in directing correct motion to achieve a goal using one main variable. For example, the gaze heuristic is catching a ball (*fig. 15*).

When a man throws a ball high in the air and catches it again, he behaves as if he had solved a set of differential equations in predicting the trajectory of the ball… At some subconscious level, something functionally equivalent to the mathematical calculation is going on.

Thus, an intuition is a judgment:

(i) that appears quickly in consciousness

(ii) whose underlying process we are not fully aware of, yet

[13] Richard O. Prum is William Robertson Coe Professor of Ornithology in Department of Ecology & Evolutionary Biology, and Head Curator of Vertebrate Zoology at the Peabody Museum of Natural History at Yale University. The New York Times selected Richard O. Prum's "The Evolution of Beauty" as one of the "10 Best Books of 2017." (*Editor's note*).

[14] Their book explains their text-mining research through a groundbreaking look at the *New York Times* bestseller list. It explores the relationship between creativity and analytics, picking bestsellers via an algorithm—"the bestseller-ometer"—with a high degree of accuracy. The algorithm exists; the code has been cracked, and the results bring fresh new insights into how fiction works and why we read. There is a translation into Russian of their book. (*Editor's note*).

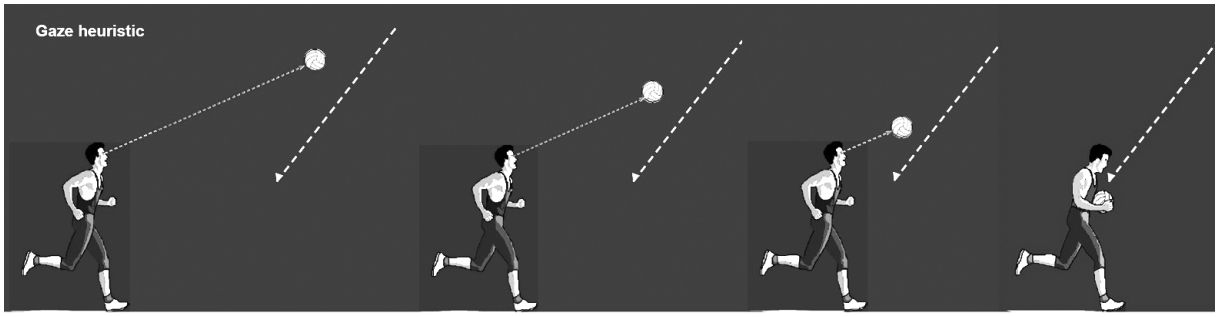


Fig. 15. **Gaze heuristic. How to catch a fly ball? Players rely on unconscious rules of thumb. When a ball comes in high, a player fixates his gaze on the ball, starts running, and adjusts his speed so that angle of gaze remains constant**

(iii) is strong enough to act upon.

What is the process underlying intuition?

- God's voice; mysterious and inexplicable
- Biases due to cognitive limitations
- Optimal weighting of all reasons
- Fast and frugal heuristics.

There is another recent paper about decision-making. Maybe, for neuroscientists it is an obvious observation, that people would not consistently give the same answer at the different time. You ask the same question, exactly the same a year later and a person gives a different answer. These researchers believe that at some unconscious level we are aware of inconsistencies and make decisions regarding risky choices based on our knowledge that we are inconsistent.

SUSAN GELMAN AND ESSENTIALISM

Here is another interesting literature. It is about works of Susan A. Gelman (born 1957, *pic. 6*) who is Heinz Werner Distinguished University Professor of psychology and linguistics and the director of the Conceptual Development Laboratory at the University of Michigan. Gelman has been a major contributor to essentialism and relating essentialist ideas to varying aspects within the field of psychology. A large number of her publications and contributions have associated essentialism and involved how its ideas can provide further insight into the field of psychology.

There are a lot of talks now about *essentialism*, that the brain organizes things by their perceived essentials — about chairs in one place, memories about vegetables in another place, as they are fundamentally different. But the categories that we place these things in are kind of arbitrary. But it becomes involved in brain structure. We tend to think about all stocks as about much the same things. But are they the same things? They just have the same name, they are all stocks.

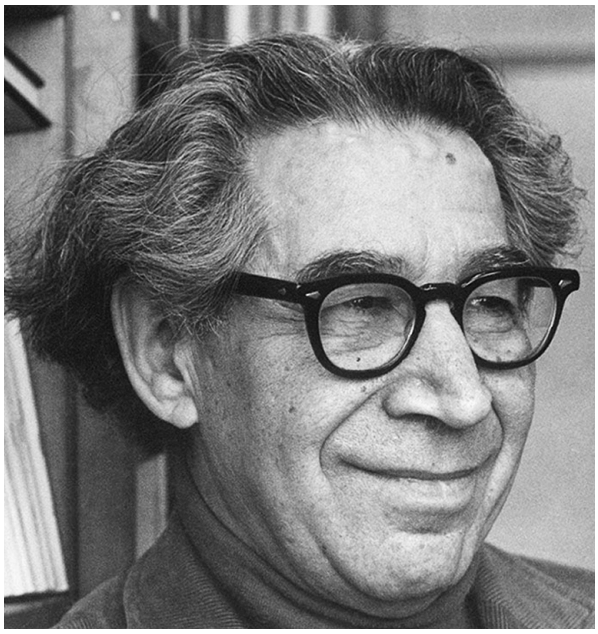
If brain stores memories according to their imagined but sometimes arbitrary "essential" qualities, why is a finely forged Rembrandt so much less valued than the "real thing"? My thought is all stocks are lumped together as essentially the same thing. What is a neurological basis for this?

Pic. 5. **Gerd Gigerenzer**

SOCIAL COMPARISON PROCESSES

Leon Festinger (1919–1989) was an American social psychologist, best known for cognitive dissonance and social comparison theory, proposed in 1954 [26] (*pic. 7*), which centers on the belief that there is a drive within individuals to gain accurate self-evaluations. The theory explains how individuals evaluate their own opinions and abilities by comparing themselves to others in order to reduce uncertainty in these domains and learn how to define the self. He is also known as the creator of social network theory for the proximity effect (or propinquity). He who argued that people are constantly making assessments of their own self-worth — that is human universal. You might have different spaces that you compete because we are naturally competitive, therefore we always comparing ourselves with others.

Pic. 6. **Susan A. Gelman**



Pic. 7. **Leon Festinger**

Let's consider three Festinger's hypothesis:

"Hypothesis I: There exists, in the human organism, a drive to evaluate his opinions and his abilities."

"Hypothesis II: To the extent that objective, non-social means are not available, people evaluate their opinions and abilities by comparison respectively with the opinions and abilities of others."

"Hypothesis III: The tendency to compare oneself with some other specific person decreases as the difference between his opinion or ability and one's own increases."

Thus, my thought is as follows: human interest in speculative investing, causing overtrading, is fundamentally related to social comparison processes.

GRATITUDE, PRIDE, ENVY, JEALOUSY...

I recently attended the annual meeting of Society for NeuroEconomics in Toronto. I would like to tell about some papers. First, it is paper titled *Gratitude and Pride* [27, p. 10]. This is a new paper that just came out, and what they did — they put people in circumstances where they did something brilliantly for themselves or they put them in circumstances where someone helped them to achieve the success. And they found there are some predictable neural circuits located in the prefrontal cortex. These feelings you have, you feel like smiling at someone who helped you, you lost something and they found something you lost. These are programs in your brain, these words gratitude and pride or envy — they reflect a brain structure. Also, humans are very interactive. Action in one person's brain spreads to another person's brain. They tell us gratitude and pride both are signals of accomplishment. While complementary, the attribution of the pride is to oneself, gratitude is to another. Acting as an emotional currency for the achievement of reward, gratitude and pride are vital to society, allowing one to build confidence and maintain relationships.

The emotion of gratitude activates the parietal and lateral prefrontal cortex. Their findings delineate the computational mechanisms of the neural circuitry for positive emotions that accompany attribution of getting reward whether it is due to one's own effort or the help of others, using computational modeling, functional MRI, and a novel behavioral task inspired by 'Who Wants to be a Millionaire' game-show.

ENVY THEORY

It might seem obvious that people have an ego. Why do some people trade stock so much, other people completely ignore it? It might be related to self-esteem mechanisms. They trade stock to prove themselves as a worthy person; some narrative brought them into these ideas. And I think of myself: maybe envy of others' investment success is a powerful driving force in speculative markets.

The word '*envy*', that meant you wish to have something that someone else has. Two scientists have written important works on this. Envy is a driving force behind animal spirit. If you hear that somebody else started a company and is now a billionaire, you feel envious; or someone else makes some investment and you did not do it, that awakens circuits in your brain that are designed to get you activated and motivated.

However, the question remains as to whether envy is a universal emotion varying only in the degree and manner it is emphasized or denied in different social formations. Or is it a social construct, absent in complex societies where hierarchy is sacralized and in simple

societies where collective unity and redistribution of goods are the highest values? In any case, contrary to popular assumptions, it does seem that envy, and especially the fear of envy, is not particularly characteristic of stable, wealthy, and self-confident capitalist nation-states.

It was in the late 1950s when Melanie Reizes Klein[15] wrote: "I have for many years been interested in the earliest sources of two attitudes that have always been familiar — envy and gratitude. I arrived at the conclusion that envy is a most potent factor in undermining feelings of love and gratitude at their root, since it affects the earliest relation of all, that to the mother." [28, p. 176] (*pic. 8*). There is also collective work [29] and Frank John Ninivaggi's book *Envy Theory*[16] [30] (*pic. 9*). Ninivaggi wrote in Introduction to his book: "Unconscious envy is the primitive sensation and conflated feeling of privation, powerlessness, inferiority, and hostile distress coupled with the urge to rob and spoil in the face of advantages and enjoyment existing elsewhere." However, behaviorally, envy can also be the core motivating force behind defacing of property, looting and setting fires to destroy other's resources, and spoiling the pleasure of others. This is part of envy's paradoxical nature — both the envier and the envied suffer. Envy theory also has correlations in sociobiology and evolutionary psychology. Although envy dynamics is profoundly intra-psychic, it is embedded in interpersonal relatedness. Thus, when and how envy of others' investment success can be a powerful driving force in speculative markets?

Ninivaggi pays attention that the discovery of the "*mirror neuron system*" (MNS) in the macaque monkey and in humans has contributed neuroscience correlates to what envy theory proposes as the biomental epistemological mechanism of knowing, "projective internalization"—identifying and understanding aspects of the environment based on their intra-psychic and intra-brain correlates with the external environment. This relationship is characterized by simultaneity, not one causing the other.

THEORY OF MIND AND MIRROR NEURONS

Giacomo Rizzolatti[17] (*pic. 10*) is the psychologist, who coined the term "mirror neurons" (also called *cubelli neurons*). He established that if a certain neuron is firing in some other person and you observe this person, the same parallel neuron will tend to fire in your brain just by observing the behavior in the other person. Rizzolatti and his research team in the 1980s [31, 32] found that the same neurons in a macaque's premotor cortex that fired when the monkey picked up a peanut also fired when the monkey watched a human pick up a peanut. In paper [32] they discuss the possible role of this system in action recognition and, given the proposed homology between F5 and human Broca's region, they posit that a matching system, similar to that of mirror neurons exists in humans and could be involved in recognition of actions as well as phonetic gestures. However, the subject of mirror neurons continues to generate intense debate until now. In 2014, Philosophical Transactions of the Royal Society B published a special issue entirely devoted to mirror neuron research [33]. Lately, in the philosophy of mind, mirror neurons have become the primary rallying call of simulation theorists concerning our "*theory of mind*" which refers to our ability to infer another person's mental state (i.e., beliefs and desires) from experiences or their behavior. On the other hand, some neuroscientists such as Marco Iacoboni (UCLA) have argued that mirror neuron systems in the human brain help us understand the *actions* and *intentions* of other people [34–36]. Despite the vast literature and intensive research, there is also an opposite view as concerns mirror neurons. In his book neuroscientist Gregory Hickok [37] reexamines the mirror neuron story and finds that it is built on a tenuous foundation — a pair of codependent assumptions about mirror neuron activity and human understanding. Hickok argues that the foundational assumptions fall flat in light of the facts. He then explores alternative explanations of mirror neuron function while illuminating crucial questions about human cognition and brain function.

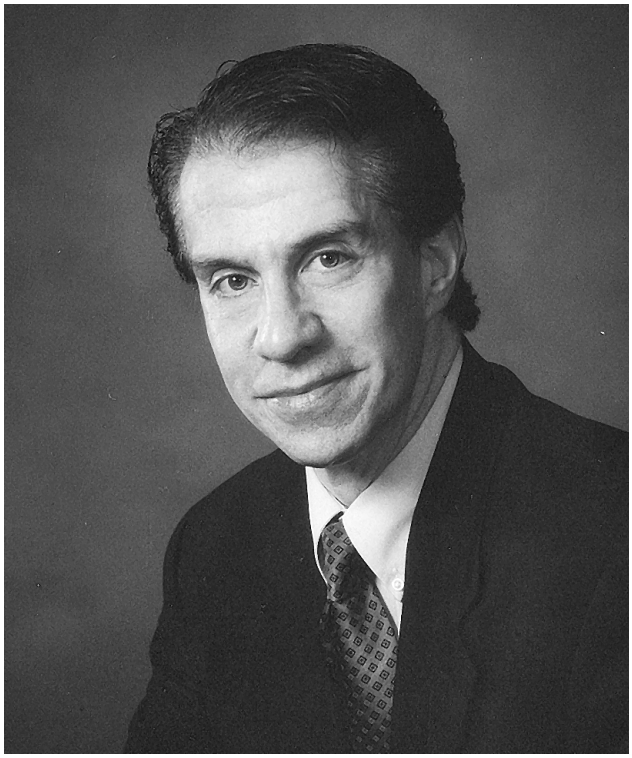
All this work is in progress and it is going to get better and better in the future.

[15] Melanie Reizes Klein (1882–1960) was an Austrian-British psychoanalyst who devised novel therapeutic techniques for children that influenced child psychology and contemporary psychoanalysis. She was a leading innovator in object relations theory.

[16] Frank John Ninivaggi, M.D., F.A.P.A., is an Associate Attending physician at the Yale-New Haven Hospital, an Assistant Clinical Professor of Child Psychiatry at the Yale University School of Medicine Child Study Center in New Haven, Connecticut and the Psychiatric Director of the Devereux-Glenholme School in Washington, Connecticut. See also his books: *"Making Sense of Emotion: Innovating Emotional Intelligence"*. 2017. Lanham, MD: Rowman & Littlefield Publishers, "*Biomental Child Development: Perspectives on Psychology and Parenting"*. 2013. Lanham, MD: Rowman & Littlefield Publishers and *Ayurveda: A Comprehensive Guide to Traditional Indian Medicine for the West*. Lanham, MD: Rowman & Littlefield.

[17] Giacomo Rizzolatti (born 1937) is an Italian neurophysiologist who works at the University of Parma. He is the Senior Scientist of the research team that discovered mirror neurons in the frontal and parietal cortex of the macaque monkey and has written many scientific articles on the topic. He is a past president of the European Brain and Behaviour Society. For CV with publication's list see http://old.unipr.it/arpa/mirror/english/staff/rizzolat.htm.

Pic. 8. **Melanie Reizes Klein**



Pic. 9. **Frank John Ninivaggi, M.D.**

SOME ASPECTS OF INVESTORS' PSYCHOLOGY IN DECISION-MAKING

An interesting puzzle is why do most people in some countries never trade stocks? The economic model we talked about when everyone is holding a diversified portfolio — not everybody is doing it. In one study [38, p. 48], they put people in fMRI[18] machines and they looked at them as they made choices between riskier and riskless bonds and they found that if anterior insula is activated that tends to predict people who actually trade in stocks. The implication here seems to be that if you are not in the stock market your anterior insula may not be properly developed!

They concluded that "Using fMRI data we show that activation in the AI [*anterior insula*] during risky (stock) versus riskless (bond) choice is associated with active stock trading in real-life." And they continue: "Risk tolerance, risk optimism, and household characteristics can correctly classify individuals as active stock traders in 82% of the cases." In a non-convenience sample of 198 working-age males (39.0±6.7 years), they used Principle Component Analysis (PCA) to identify two important categories of factors driving active stock trading ("Do you trade stocks yourself?"), which they termed risk tolerance and risk optimism. They combined an extensive set of cognitive and non-cognitive skill measures, rich data on socio-demographic characteristics, as well as brain activation from a functional magnetic resonance imaging (fMRI) stock learning paradigm to explain real-life stock trading behavior.

Now there is another thing. Theoretical finance talks about risk and *risk aversion* and it describes rational people who want to know the probabilities. You can ask them a question: would you make this investment if it had a 70% probability of going up 10%, but a 30% probability of going down 15% and they talk about rational people taking decisions on that basis, but in fact most financial decisions do not come with probabilities like that — in fact, they are usually ambiguous. There are also some works from neuroscience [39, 40]. In studies of attitudes towards risk G. Christopoulos [41] has suggested that the activity of a specific brain area (right inferior frontal gyrus) correlates with risk aversion, with more risk-averse participants (i.e. those having higher risk premia) also having higher responses to safer options. This result coincides with other studies [39, 40], that show that neuro-modulation of the same area results in participants making more or less risk-averse choices, depending on whether the modulation increases or decreases the activity of the target area. Risk

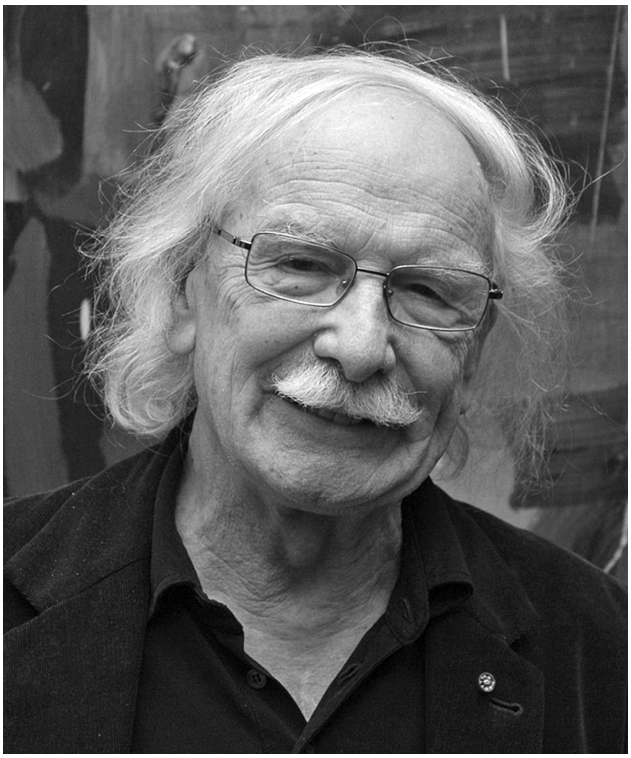
[18] Functional magnetic resonance imaging, or fMRI, is a technique for measuring brain activity. It works by detecting the changes in blood oxygenation and flow that occur in response to neural activity — when a brain area is more active it consumes more oxygen and to meet this increased demand blood flow increases to the active area. fMRI can be used to produce activation maps showing which parts of the brain are involved in a particular mental process. For details, see https://psychcentral.com/lib/what-is-functional-magnetic-resonance-imaging-fmri or http://fmri.ucsd.edu/Research/whatisfmri.html.

aversion is the behavior of humans (especially consumers and investors), when exposed to uncertainty, in attempting to lower that uncertainty. For example, a risk-averse investor might choose to put his or her money into a bank account with a low but guaranteed interest rate, rather than into a stock that may have high expected returns, but also involves a chance of losing value.

However, there is also a phenomenon called ambiguity aversion. *Ambiguity aversion* (also known as uncertainty aversion) is a preference for known risks over unknown risks, that is, an ambiguity-averse individual would rather choose an alternative where the probability distribution of the outcomes is known over one where the probabilities are unknown. This behavior was first introduced through the Ellsberg paradox. It was an experiment done to show that people do not like ambiguity, and it's very different from saying they don't like large probabilities of extreme events. Ellsberg found, essentially, that people prefer to bet on the outcome of an urn with 50 red and 50 blue balls rather than to bet on one with 100 total balls but for which the number of blue or red balls is unknown.

There are parameters that researchers in finance do not fully see yet, but they are starting to understand. I think that a revolution in financial theory is happening. The reason you haven't bought stocks may be because you had some stressful events in your childhood that trouble you and you cannot make yourself to bet on something so ambiguous in your mind. Lu et al. [42] used self-reported state anxiety levels which were collected using the State-Trait Anxiety Inventory before a choice task, and lifetime stress exposure levels which were measured afterward using the Stress and Adversity Inventory (STRAIN). They concluded that ambiguity aversion, but not risk aversion, is associated with cumulative lifetime stress exposure. Indeed, decisions are often made when the probabilities of different outcomes are unknown (i.e., ambiguity). Thus, they used a standard experimental economic paradigm that dissociates attitudes toward risk and ambiguity to assess how lifetime stress exposure affects economic decisions regarding uncertainty. Their "findings suggest that lifetime stress exposure accounts for the lion's share of individuals' tolerance for situations with ambiguous reward probabilities, but has little effect when the outcome probabilities are precisely known. Since most decision-making falls into the former category, this has implications for healthy and chronically stressed populations alike and their economic behavior in a broad range of ambiguous contexts (e.g., retirement investing, real estate)" [42, p. 49].

People do not always give the same answer at different times when presented with the same risk choice. It is attributed to the noisy internal representation of the decision situation. Can we consider oblique bias (Mach's



Pic. 10. **Giacomo Rizzolatti**

oblique effect), that is, the relative deficiency in perceptual performance for oblique contours as compared to the performance for horizontal or vertical contours, where visual acuity depends on the angle of orientation, as an analogy for perceptual bias regarding large and small risks? Khaw et al [43] presented a unified theory of random variation in choices between risky prospects, and departures from risk-neutrality (in both directions), is, as proposed, paralleling an explanation that has been offered for both stochasticity and bias in perceptual judgments, including judgments of numerosity [43, p. 25]. Individuals may have different *risk attitudes*, namely, to be:

risk-averse (or *risk-avoiding*) — if he or she would accept a certain payment (certainty equivalent) of less than $ 50 (for example, $ 40), rather than taking the gamble and possibly receiving nothing;

risk-neutral — if he or she is indifferent between the bet and a certain $ 50 payment;

risk-loving (or *risk-seeking*) — if he or she would accept the bet even when the guaranteed payment is more than $ 50 (for example, $ 60).

According to above view, both the randomness of choices and the average bias result from the fact that choices must be based on a noisy internal representation of the decision situation, rather than on an exact description of it. Noise in the coding of the data that define the problem results in stochastic choice (conditional on the true situation), and an optimal decision rule (from the standpoint of expected wealth maximization) implies

behavior that (from the standpoint of an experimenter who knows the true data) appears to violate risk-neutrality. Their experiments document both randomnesses in subjects' choices when presented repeatedly with the same risky prospects, and the "fourfold pattern of risk attitudes" reported by A. Tversky and D. Kahneman [44]. The most distinctive implication of prospect theory is the fourfold pattern of risk attitudes. Specifically, it is predicted that when faced with a risky prospect people will be:

(1) risk-seeking over low-probability gains;
(2) risk-averse over high-probability gains;
(3) risk-averse over low-probability losses;
(4) risk-seeking over high-probability losses.

They concluded their computational model provides a functional explanation for several of the main non-normative aspects of behavior summarized by prospect theory, linking them to the need to economize on the neural resources used to represent numerical magnitudes when evaluating risky prospects. The theory also predicts new phenomena (notably, payoff-magnitude-dependence of the apparent distortion of probabilities) not predicted by prospect theory, but confirmed in our experimental data as well as other studies.

QUESTIONS FOR FUTURE WORK IN NEUROECONOMICS

Upon my reading of the recent neuroeconomics and economics literature, I see some questions that appear fruitful for researchers now:

What brain processes trigger mass response, intense public attention?

How do symbols, metaphor, analogy spur inspiration?

How does the human interest in a story function?

How does the brain recognize beauty, innovation?

How does brain manage social comparison processes, envy?

How is a theory of mind, attention to other people's thoughts, managed in the brain?

How are emotions like fear managed through time, and over economic events?

What role do visual images and auditory memories play in economic decisions?

What distinguishes people who are vulnerable to fake news stories?

I am going to include some final thoughts on neuroeconomics and why I think it would be really important in the future. I started this lecture about narratives and how they spread virally and how they activated people's animal spirits or the opposite — how does it not work. There are questions that have to be addressed in neuroscience: what brain processes trigger a mass response? How symbols, metaphor, analysis how humans function, how does brain recognize beauty and innovation, how does it do this? Theory of mind represents what other people are thinking, how these things are managed in the brain, how emotions are managed through time. How do these questions relate to the contagion of economic narratives? One idea is that a story is contagious because of irrelevant details added to the story.

Let me dwell on this for a moment. The Roman senator Marcus Tullius Cicero (106 BC — 43 BC) around 2000 years ago in a book *De Oratore* said: if you want your speech to be remembered, give visual images, something people can remember as if they saw it. Now, let's take one of these experiments about the impact of narratives. A team of scientists conducted an experiment in a trial [45]. They had two different presentations of the same facts. One got all the facts out as if a lawyer was trying to get a conviction. The other version had the same facts but they were embellished with irrelevant details. It sticks in my mind the example they mention. The accused lurched across the room and accidentally spilled a dish of green guacamole and then did the crime — that was one version. Whether he spilled some food or not was irrelevant, but it is a visual image and everyone remembers that fact. The juries that got this other version were more likely to convict.

I guess I'll stop here. What I have presented here is kind of a model for future research in all social sciences and for the linkages with other sciences that you would not have thought, namely of neuroscience. And it is my prediction that economics will over the next decade change fundamentally and this attachment to rational individualistic human behavior will be substantially replaced.

DISCUSSION

Thank you so much for your presentation. This is fascinating. The neuroeconomics is something we have been waiting for decades. I am curious about the global financial crisis. By any chance have you ever noticed the most popular narratives on Google or elsewhere? Could you forecast crisis by analyzing some particular crisis? Could your forecast that?

Yes, I cannot claim to have been doing a systematic study of these narratives. It takes a lot of time. I have the impression that it might be a false memory, but I know that I have felt that the narratives were changing both pre- and post-financial crisis. I used to go out with my wife to a restaurant and I'll say I bet I hear from a conversation at nearby tables something about home prices. Everyone was talking about it. I did not listen in, but I just remember hearing about prices and I told her that I was quite successful with so many people talking about home prices. I think that I had a feeling that self-esteem was tied up, a lot of people found out that "I have discovered myself because I am trading houses now. I buy houses that

are rapidly appreciating in value." And you would hear stories about people who made a lot of money doing this. I actually do questionnaire surveys of people's attitudes during the financial crisis and I went back with them that had open-ended questions and I discovered that in 2003 and 2004 nobody said "housing bubble", but starting in 2005 it changed, and now it is seen in Google Books Ngram Viewer etc. Something was changing at that time. There were stories about stupid investors stupidly engaging in the flipping of houses. I do not know if you know this English term[19]. Around 2005, just before the financial crisis, this new term appeared. What does it mean to flip a house? To buy a house as an investment and plan to sell it after some brief cosmetic improvements and sell it at a much higher price — that is flipping a house. Nobody said this term, "flip a house" did not exist before. I said then, around 2005, that the end of the bubble was near. I did actually come out with it and said this in various newspaper's interviews, with some diffidence. Going back to the stock market crash of 1929—the really big event that has become a legend, that people still talk about. Let's go back and read newspapers and sermons from that time to see what people were saying. And I think I am doing this ex-post, in an informal way, but there was a change in public talk just before the 1929 crash. The change in the public talk was more about crazy investors, there was a focusing on debt, people were borrowing money to buy stocks. People were saying in 1929 before the peak that some people have been borrowing 90% of the money to buy stock — that is crazy! Not everyone said that, but it was started to come in as the new epidemic. You can see these things, but it is hard to systematically prove them.

Professor Shiller, thank you for this interesting lecture. My question: the higher market uncertainty is for individual companies the higher level of passive investment to ETF, for example. Do you think that the fear of being vulnerable to viral contagion on financial markets, on the contrary, reinforces the effect of that viral contagion but kills narrative contagion?

Passive investment is growing now. What passive investing means is not trying to be stock market, it means putting your money into some index fund, like that. Why is that growing now? That is an interesting question. It parallels with another issue which is volatility in the world stock market. I am talking in particular about US stock market — volatility has recently been at historical lows. Does anyone know why? It may go along with passive investment. In a current moment in history, I cannot quite say accurately, but people are not so emotionally involved in investment now, they are not jumping in the moment like they would. I also have concerns about passive investment. We see the US market continuing growing. At the same time, it is not people who are paying much attention. I do not know how safe this is. I am worried, but I do not have a final bottom line to give you.

Thank you very much for an interesting lecture, Professor. I am from the Financial University. Question: I have been actively following your activity, scientific activity. I really liked your statement many years ago, and I quote: Another important thing is the pressing need to combine economy with science about the brain — that you do. People are now studying how the brain affects economic activity, and in the future, their discovery should be applied to economic policy. I am totally agreeing with your opinion, and I want to say that our University is also conducting a very serious research in this field. Some of the results that we obtained are consistent with yours. In particular, the work of a brain under conditions of uncertainty. How brain structure affects economic decision-making? Here we have some fundamental findings. Is it possible to share our findings with you? Maybe, you can suggest something?

I mentioned there the Society for NeuroEconomics that has annual meetings that are international in focus. The next meeting is in Philadelphia next fall. One thought is to go to that meeting. I was thinking there should be a Russian venue for that meeting as well. There have been meetings around from country to country. It is still a new field, but there are a lot of people there who may be interested in your research. I think that the problem you face is typical for important research and reflexes the problem that I showed in my chart. If you are doing something really important, it probably won't get attention until 5 or 10 years have gone by. It won't get mass attention until a lot of time passes by. I find myself advising students about it, young students, why have the job terminated if they don't get enough attention to their theories if they are ignored? They often try to do the popular thing, but I do not think that it is a good strategy. You are better off doing important work that is unappreciated today because I think in fact the hiring decisions, the promotion decisions do depend on some people who will look at the work and think about

[19] Flipping is a term used primarily in the United States to describe purchasing a revenue-generating asset and quickly reselling (or "flipping") it for profit. Though flipping can apply to any asset, the term is most often applied to real estate and initial public offerings (IPOs). The term "flipping" is used by real estate investors to describe "residential redevelopment". Redevelopment of distressed or abandoned properties or neighborhoods has sometimes been linked to malicious and unscrupulous acts in the post-housing bubble era. The term "flipping" is frequently used both as a descriptive term for schemes involving market manipulation and other illegal conduct and as a derogatory term for legal real estate investing strategies that are perceived by some to be unethical or socially destructive. See, for example, https://en.wikipedia.org/wiki/Flipping or http://www.businessdictionary.com/definition/flipping-houses.html. (*Editor's note*).

it, think: is this exciting potentially or not? There is a problem, especially among young people who have not been through the life cycle; they think they need to be the standard thing that everyone is doing. You should do something you believe in and you mail it to people you think will understand. Maybe, it would not get into a journal, but it does not matter. You begin an epidemic if you are indeed creative and it optimally will be a success. It is my advice not to you, but to young people at all. There is too much cynicism among young people who think they should think alike like the others around them. They have to do research with the great men. You just do what you believe in! Even the great men, who you thought would reject you, will turn to like it eventually.

What is your opinion on the theory of leverage cycle? Do you know what this is?

It refers to something that I have already mentioned. Just before the last big recession, the so-called Great Recession 2007–2009, data showed big increases in leverage. Mortgage lenders in the United States and elsewhere were allowing homebuyers to borrow a higher fraction of the purchase price of the homes. Homeowners were "leveraged," meaning their debts were a big part of their home values, so if home prices go up a lot, they will make a lot of money. But, a drop in home prices could mean they would lose everything. But during the recession home prices actually fell, and so in millions of cases, homeowners became "underwater", meaning they owed more than their home was worth. So, feeling the pinch, they stop spending, and the economy suffered. That is the so-called leverage cycle. This is sometimes presented as a purely rational cycle. I guess, maybe, it could be in some sense rational to borrow a lot to buy a house, but it is also an irrational cycle if homeowners, when they are borrowing, are just failing to see the potential for loss. It is the question what stories you are telling about that. I remember there was one book of advice, entitled *The Complete Guide to Flipping Properties* by Steve Burges (Hoboken NJ: Wiley, 2004). "Flipping" a property means buying and selling a house shortly thereafter at a big profit. The book claimed this is easy to do. This book was written during the boom before the financial crisis. The author was telling stories. He was someone who wanted to sell books and trying to go viral and sensed that this was the time. I imagine the author was talking to a publisher and a publisher said you know the housing market is hot now, and people are selling books, go for it, but you have to do it now! In this book, he talks about leverage and he says "It [leverage] allows you to take a little bit of your own money and maximize return on it." (p. 7.) He calls it the "OPM Principle," meaning, whenever you can, you should profit by investing "other people's money." Borrow as much as you can from other people. But when I think about it — wait a minute, I invest 90% other people's money in buying a house, but I can go bankrupt doing that. If prices go down by just 10% I am bankrupt, what does he say about it? The book said nothing about that. The book was saying that smart people are investing other people's money and you should too. And there was not a word about the dangers of leverage. This kind of deception is something not captured by economics literature. This person who wrote a book was involved in manipulation and deception to sell books. Did some of it make readers successful? For a while, maybe, while he was selling this book.

Hello, thank you for your lecture. My question would be about regulation in financial markets because you did a lot of work to get a Nobel Prize in researching financial markets. What do you think of a new reality — is the financial system more trainable or not, taking into account two facts or tendencies: the amount of information grows and the growth rate of the amount of information in the social media and so on? We have more and more information, i.e. stories can spread faster. We have not enough capacity to check all the facts, all the information, that is why we have this problem of alternative facts like news. The second tendency: a lot of people have very easy access to financial services like cryptocurrencies, ICOs, you know about that I think. Do you think that the public can invest money, does it make the financial system less stable or is this a non-event?

There is a big global question. I am not sure that I can answer. I was feeling enthusiastic about both the great proliferation of information and also about a new regulation that tends to combat new problems. So what can I say? You mentioned things like you do need regulation, especially now, the very thing as you describe it, a new digital information network that we have made, make it possible for people to deceive and manipulate at a much faster rate; it requires a bigger budget for regulatory agencies to stay on top of this thing. So you mentioned ICOs, initial coin offerings, glamorous new things, they started just about a year ago. It is a new expanding bubble of enthusiasm, as they explore cryptocurrencies. Bitcoin was recently above 8000 dollars. What is going on here? It seems to me it is a narrative explosion. It is getting harder and harder for regulators to keep up with it. There is so much going on. There used to be if you had a financial product, you could not target it for certain audiences, you had to buy ads in major newspapers, it would be a big thing and regulators could see it, everyone would see the same thing. But now, there are products sold to individuals, who belong to minority groups, it is tailored to them. They experiment with ways of getting past your defenses. I do not know what it is like here in Russia, but last week I got like 60 phone calls from robot sales people trying to apparently fool me into thinking I am talking to a real person. The ability of digital commerce is rapidly growing.

Thank you, it is very interesting. My question: you began with the narrative. Now the narrative is 99% visual. We are speaking about Homo Videns. Nobody is reading books. 99% of young people are watching iPhone. The future is that narrative will be visual. And visuality is an equivalent of manipulation. Now we have Google that is able to understand what everyone here may desire. Are you speaking of the end of democracy at all?

I am hearing here more and more difficult and big questions. Yes, I worry sometimes about democracy. On the other hand, we are learning, they are likely to be manipulating. I wish I understood. Are we going through a historic change? New digital technology is really a historic change in society. We have to learn how to live with the dangerous new technology that offers wonderful things. I am happy because of the Internet, I like finding things out. I am searching the Internet continuously just to find out what is up, what is happening. I begin to be aware of deception and manipulation which is everywhere.

I am from 'Finance, Education, Protection of Investors' Rights' journal. In the context of your research, I have a question: music is the product of a genius, which is almost identical to the natural singing of birds, as happened with Mozart. Maybe, there is a same situation in the economy when we can predict the occurrence of irrational manipulation, or warn about it by writing 'sheet music' for economic development? Thank you.

We were talking about different definitions. You said Homo Videns. Other people have suggested our species should be called Homo Musica, which is Latin for Man the Musician because music is unique to the human species. There are no other species that makes music. Maybe bird songs, but not quite a music. So I am thinking that music is somewhat… I am trying to answer my way… Music is something like a narrative. In the most music, there are words, and songs are like stories. A minority of music is without words, but there are some kinds of music that are without words. For example, Beethoven's Pastoral Symphony. It is common knowledge that it represents a beautiful day outside with a rainstorm and thunder in the middle. This is one of Beethoven's more famous symphonies. There are no words, but it is a narrative still. Mystery: what is that the composer does that can be so memorable and so rare and unique? I am thinking it is somewhat similar. There is someone who analyses novels for what makes a successful novel. We can do that with music as well I suppose. The human mind is still inscrutable.

Thanks a lot for your very interesting lecture. My question is related not to this one, but the previous one. You mentioned machine learning at the beginning; you also mentioned big data and machine learning. Machine learning is not really cognitive artificial intelligence; it is a mere reproduction from examples — a lot of examples. Now depending on which examples one takes, one may create a trend, completely artificial, with ethical implications of course in terms of prejudice and so on, but particularly relevant economic implications. One may let people believe in a new bubble or a new kind of interesting business and so on. How could we humans manage or the financial markets manage this?

You talk about big problems that I do not have answers to necessarily. Machine learning is a force in our society that could start a bubble. It reminds me of a talk about driverless cars. You are sitting in an automobile that is been driven by a machine, suddenly it stops. You cannot ask the driver why he stopped. You have to think why did it stop here? Maybe because it involves some machine learning algorithm and it saw some examples when the accident occurred, and it is following its machine learning protocol. Maybe the machine has learned, the car has learned that when other traffic stops you should too because maybe they know something. There could even be a chain reaction, which something develops in driverless cars that puzzles everybody and looks like a bubble. And there is no way to find out, as there is no human who could tell. These are interesting stories. I do not have a ready solution for them.

I am from Thomson Reuters, Financial University. My question is unrelated to the topic of this forum. What does the future hold? How can we influence it? Do you think by concentrated efforts of government and media, society, we can create the right narrative, the narrative that then creates the desired reality?

We try to do this, but it does not necessarily work and the narrative can change. In the US we have a narrative about George Washington, the first president, who did many wonderful things. We can tell you these stories. But he was under fire because he owned slaves. This has been publicized recently, and it is considered very bad. It turned out that he had a black slave named Ona Judge, a young woman who ran away, and she spends the rest of her life trying to run from him and his minions. She has outsmarted him, he had never caught her. This year, a woman published a book about her. It is bizarre that now we have a novel (*Never Caught*, by Erica Armstrong Dunbar, Simon & Schuster, 2017) in which the villain, the bad guy, is George Washington. It is hard to control these things. That is what makes it a narrative. We used to have George Washington narrative that made him an unambiguously wonderful man. But these things have a way of propping up and changing the whole story. I do not have an answer. Presumably, people teach children good narratives that will make them into good citizens. But I guess we are being a little bit manipulative when we do that.

I would like to ask you for continuation your presentation. You talked about the brain, about the neurophysiology,

and can tell us more. Is it possible to align the structures of the brain with the financial and economic indicators of community or economic groups?

I bet there are thousands of papers written on it. I am not a neuroscientist, but I can reassert you that we have regions in our brain that are designed to facilitate social relations. What is notably — we have a region in the brain called the fusiform gyrus which is essential to recognizing faces and it is actually amazing how quickly we can recognize individual people in a crowd. The brain can do this at a distance in an instant. That is a remarkable capability and it is represented by certain sections of the brain. So, the brain is evolved to devote a lot of the energy and memory to recognizing faces. Why is that? I think it had to do with over the years millions of years of evolution that it was very important to know who your friends and enemies were, or who could be handled in a certain way so that our brain reflects that in our structure. There is so much of this that I can tell you about, I am sure.

If we move from George Washington to a decade of the early 2010s, after Barack Obama came to power and there was a host of behavioral economists who was meant to help him instill and implement new attitudes and mindsets. Now those two terms of his office are over. What efforts have been helpful? That question refers to your optimism about neuroeconomics.

I actually met some of the people. President Obama created a team in 2015, The Social and Behavioral Sciences Team (SBST), that was modeled after the British Behavioral Insights Team (BIT, or Nudge Unit after a 2008 book by Richard Thaler and Cass Sunstein [46]) set up under Prime Minister David Cameron in 2010. I met people from both teams and I was impressed by them. The U.S. Team is gone now under President Trump. The U.K. Team has been privatized.

What were the attempts made by those behavioral economists during two terms in Obama's office? Did they bring any results?

Yes, there are some good examples. The SBST has changed the way information is offered, with targeted outreach, to farmers, under a government micro-lending program. The SBST has helped student loan borrowers, who in many cases in the U.S. have high debts, to manage their debt by prompting the choice of more-affordable repayment plans and promoting annual recertification among those already in plans.

First, thank you for the lecture, an excellent lecture! I am most impressed by what you said about models being distributed narratives of familiar things for people, and that they are fairly well defined, repeated, and so on. It seems that not only they are so good, but other models too. I think your lecture suggests that repetitive things (and this is crucial for understanding the model) are not as random as we always think. What do you think about this?

Ok, thinking about economic models. One thing that really makes a model to go viral is to be included in the principles course, as for example the IS-LM model. I would not get into details, but it was very viral because it superficially looked like tidying up of Keynesian economic theory. Another contagious model was the real business cycle model that went viral much more recently. It was a little bit like bitcoin because it was considered a defense of rationality that was under attack from behavioral economics. Behavioral economics was beginning in the 1980s to chip away what the economists had as concerns human rationality. The real business cycle models try to describe the economy in terms of an even more relentlessly rational framework, and the kind successors, so it was the new form of evidence that came at an opportune time, right at the time Ronald Reagan was elected president and Thatcher were elected PM of the UK. There is something about timing and as marketers will tell you there are times when people are hungry for a certain idea and it may become suddenly popular. I am sure people will think about submitting journal articles hoping to make everyone aware of their thought and make it go viral.

I am a student at the Financial University and I want to join all the other people and thank you for a very interesting presentation. My question will refer to the theme of our forum, i.e. about cryptocurrency, like bitcoin and etherium. I just want to know your opinion. Will this trend go further or will it go down?

Bitcoin price had two bubble phases. The first one was surely after it was issued and the bubble peaked around 2013 and then collapsed. And it looked like bitcoin got fading away. But it then hit another bubble period and reached even new heights and I think that the new bubble period coincides with some news about it that rekindle the interest and bring the contagion back. The ICO has come quite recently. Another one is the development of new branches like bitcoin cash that brought people's attention back to the bitcoin experience. I am arguing that bitcoin is in a bubble now, but bitcoin enthusiasm counts. You might say that ordinary currency is a bubble because the paper that you are walking around with has no intrinsic value. It only has value because people think it does. The same is happening with bitcoin. They could be right that will somehow be important. I think about this as largely as a story phenomenon. It is a success because of the excitement it generates; it is not the same as the success of gold — gold has much more value that it would have as it was thought to be valuable. Why do people think it is valuable? Is it just yellow stuff you find in the dirt? Why value it at such high amount? I guess a lot of things are like that. I think that bitcoin stands out as it

was the first and it has a great story. The story is about Satoshi Nakamoto who cannot be found and may never have existed. There is a mystery to it. It has an insider quality because I have suspected most of you here do not even understand how bitcoin works because if you try to understand it, it will take weeks. You have to take a course on cryptocurrency to understand it. It has sort of an insider excitement about it, only a few of us understand it. It has led to a very successful narrative. I do not think it is as stable as narrative behind gold, but I am not sure. I cannot rule that out. Maybe, it will still be traded in a thousand years. We alive today will never find that out.

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ИНФОРМАЦИЯ ОБ АВТОРЕ

Роберт Дж. Шиллер — профессор экономики в Департаменте экономики Йельского университета и Фонда Коулза, занимающегося исследованиями в области экономики, профессор финансов и научный сотрудник Международного центра финансов Йельской школы управления. Получил степень бакалавра в Мичиганском университете в 1967 г. и степень доктора наук в Массачусетском технологическом институте в 1972 г. Темы научных публикаций — финансовые рынки, финансовые инновации, поведенческая экономика, нарративная экономика, нейроэкономика, макроэкономика, недвижимость, статистические методы, общественные взгляды, мнения и моральные суждения относительно рынков. Его индекс цен на жилье на вторичном рынке, первоначально разработанный совместно Карлом Кейзом, используется сейчас агентством CoreLogic и опубликован как S&P/Case-Shiller индекс движения цен недвижимости. Чикагская товарная биржа поддерживает фьючерсные рынки на основе индексов S&P/Case-Shiller.
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